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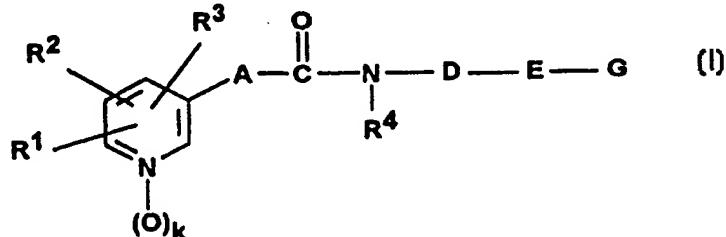
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(54) Title: PYRIDYL ALKENE- AND PYRIDYL ALKINE- ACID AMIDES AS CYTOSTATICS AND IMMUNOSUPPRESSIVES

(57) Abstract

The invention relates to new pyridyl alkene and pyridyl alkyne acid amides according to general formula (I), as well as methods for their production, medicaments containing these compounds as well as their medical use, especially in the treatment of tumors or for immunosuppression.



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PYRIDYL ALKENE- AND PYRIDYL ALKINE- ACID AMIDES AS CYTOSTATICS AND IMMUNO-SUPPRESSIVES

The invention relates to new pyridine compounds, methods for their production, medicaments containing these compounds as well as their use, especially in the treatment of tumor conditions and/or as cytostatic agents or as immunosuppressive agents.

A pressing need exists for cytostatic therapy to provide new pharmaceuticals and/or medicaments which not only possess a strong activity, but also exert diminished side effects in comparison to many classical cancerostatic agents, whereby treatment of a broad as possible spectrum of tumors should be made accessible. Furthermore, effective cytostatic agents for an efficient therapy should be made available. Active ingredients of this type should also be exceptionally suitable in the mentioned indications for a combination therapy, be it in connection with other cytostatic agents or with radiation (for example X-rays, radioactive elements, such as cobalt, or linear accelerator, etc.), with operative procedures, heat treatment, etc.

In this connection, a strong need also exists to enrich tumor therapy with new compounds for overcoming or preventing resistances for example.

This object was successfully solved in a completely surprising manner by making available the pyridyl alkane acid amide derivatives defined below.

It was known that various pyridine compounds substituted in a specific manner have pharmacologically useful properties which lie however in completely different indication areas.

Thus, ω -pyridyl alkane and/or alkene amides with anti-allergic activity are described in EP 0 210 782 which are referred to as having a 5-lipoxygenase-inhibiting and anti-histamine action, wherein the amide components of these compounds contain a piperazine or homopiperazine ring and the pyridine ring can be linked together in the 2-, 3- or 4-position. JP 63,179,869 describes further pyridyl amides, ω -pyridyl alkane and alkene amides as anti-allergic effective substances containing a substituted piperidine ring in the amine component. Such compounds with the same properties are mentioned in Chem. Pharm. Bull 37, 100-105 (1989) and in J. Med. Chem. 1989, 583-593.

Pyridyl ureas, pyridyl thioureas and pyridyl carbonamides, wherein the amide portion is bound over an aryl substituted alkyl chain with a piperidine ring or piprazine ring, are described for example in EP-A-0 428 434 or in EP-A-0 512 902 as antagonists of the neurokinin receptor and substance P. Furthermore, pyridyl(alkyl)carbonamides, pyridyl(alkyl)sulfonamides and analogous ureas, wherein the amide portion is bound over an alkyl chain with a piperidine ring are disclosed in EP-A-0 479 601 as active ingredients with anti-arrhythmic properties.

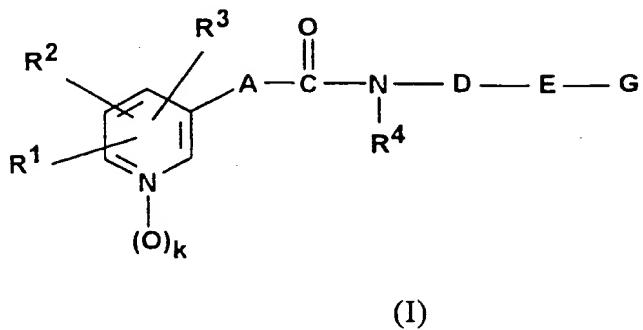
In WO 91/15 485, the production of pyridine-3,5-dicarboxylic acid esters and amides as well as their use for the treatment of tumor conditions is described. These compounds differ from the compounds according to the invention described below in very important structural features, for example by the dicarboxyl grouping on the pyridine ring or the absence of the hydrocarbon chain between the pyridine ring and the amide grouping. The compounds disclosed in WO 89/07 443 in the form of optically pure R(-)-Ni-guldipine and further analogous dihydropyridines with cytotoxic activity have larger structural differences. As compared to these known compounds, the compounds according to the invention unexpectedly possess a better activity and a wider spectrum of action despite the large structural differences.

Structurally closely related compounds are represented by the piperidine compounds described in EP-A-0 330 026. However, no 3-pyridyl derivatives were concretely described and no concrete examples were disclosed in this publication, aside from a single compound which is described below. These known compounds are distinguished by an anti-cholinesterase activity, an anti-amnesia activity as well as activities directed against hyperkinesia, senile demensia, mania and Alzheimer's disease.

In view of this art, the finding that the compounds according to the general formula (I) defined below have activities which make them particularly suitable in an excellent manner for the therapy of tumor illnesses was completely unexpected. The pharmacological finding that the compounds according to the invention also possess immunosuppressive properties besides cytostatic activity is to be considered as equally surprising.

Pharmacological test results from which this conclusion must be drawn, as well as the concrete tumor indications and combination possibilities are detailed and illustrated in the last part of the description.

Therefore, subject-matter of the invention relates to compounds of formula (I)



wherein

- R¹** is hydrogen, halogen, cyano, trifluoromethyl, hydroxy, benzyloxy, aminocarbonyl, carboxy, phenyl, phenoxy, phenylthio, pyridyloxy, pyridylthio, alkyl, especially C₁-C₆-alkyl,
- alkenyl, especially C₃-C₆-alkenyl,
- alkinyl, especially C₃-C₆-alkinyl,
- hydroxyalkyl, especially C₁-C₆-hydroxyalkyl,
- alkoxy, especially C₁-C₆-alkoxy,
- alkenyloxy, especially C₃-C₆-alkenyloxy,
- alkinyloxy, especially C₃-C₆-alkinyloxy,
- alkanoyloxy, especially C₁-C₇-alkanoyloxy,
- alkoxycarbonyloxy, especially C₂-C₇-alkoxycarbonyloxy,
- alkylthio, especially C₁-C₆-alkylthio,
- alkenylthio, especially C₃-C₆-alkenylthio,
- alkinylthio, especially C₃-C₆-alkinylthio,
- cycloalkyl, especially C₃-C₈-cycloalkyl,
- cycloalkyloxy, especially C₃-C₈-cycloalkyloxy,
- cycloalkylthio, especially C₃-C₈-cycloalkylthio,

alkoxycarbonyl, especially C₂-C₇-alkoxycarbonyl,
alkylaminocarbonyl, especially C₂-C₇-alkylaminocarbonyl,
dialkylaminocarbonyl, especially C₃-C₁₃-dialkylaminocarbonyl, or
NR⁵R⁶, wherein

R⁵ and

R⁶ are selected independently of each other from hydrogen,
alkyl, especially C₁-C₆-alkyl,
alkenyl, especially C₃-C₆-alkenyl and
alkinyl, especially C₃-C₆-alkinyl,

R² is hydrogen, halogen, cyano, hydroxy, trifluoromethyl, benzyloxy,
alkyl, especially C₁-C₆-alkyl,
alkoxy, especially C₁-C₆-alkoxy or
alcanoxy, especially C₁-C₇-alcanoxy,

wherein R¹ and R², if they are adjacent, optionally form a bridge which is selected from

-(CH₂)₄-, -(CH=CH)₂- and -CH₂O-CR⁷R⁸-O-, wherein

R⁷ and

R⁸ are, independently of each other, hydrogen or alkyl, especially C₁-C₆-alkyl,

R³ is hydrogen, halogen, alkyl, especially C₁-C₆-alkyl, trifluoromethyl or hydroxyalkyl, especially C₁-C₆-hydroxyalkyl and

R⁴ is hydrogen, hydroxy, benzyloxy,

alkyl, especially C₁-C₆-alkyl,
alkenyl, especially C₃-C₆-alkenyl,
alkinyl, especially C₃-C₆-alkinyl,
cycloalkyl, especially C₃-C₆-cycloalkyl or
alkoxy, especially C₁-C₆-alkoxy,

k is 0 or 1,

A is alkenylene, especially C₂-C₆-alkenylene, which is optionally substituted once to three-fold by C₁-C₃-alkyl, hydroxy, C₁-C₃-alkoxy, fluorine, cyano or phenyl,

alkadienylene with at least four C-atoms, especially C₄-C₆-alkadienylene, which is optionally substituted once or twice by C₁-C₃-alkyl, fluorine, cyano or phenyl,

1,3,5-hexatrienylene, which is optionally substituted by C₁-C₃-alkyl, fluorine, cyano, or phenyl,

ethinylene

D is selected from alkylene, especially C₁-C₁₀-alkylene, optionally substituted once or twice by alkyl, especially C₁-C₆-alkyl, hydroxy, or alkoxy, especially C₁-C₆-alkoxy,

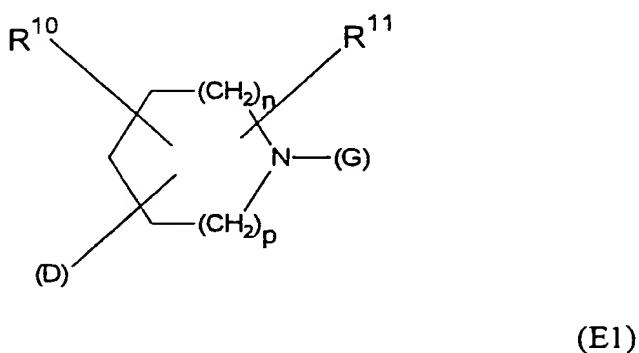
alkenylene with at least two C-atoms, especially C₂-C₁₀-alkenylene, which is optionally substituted once or twice by alkyl, especially C₁-C₆-alkyl, hydroxy, or alkoxy, especially C₁-C₆-alkoxy, wherein the double bond can also be to ring E,

alkinylene with at least three C-atoms, especially C₃-C₁₀-alkinylene, optionally substituted once or twice by alkyl, especially C₁-C₆-alkyl, hydroxy or alkoxy, especially C₁-C₆-alkoxy, and

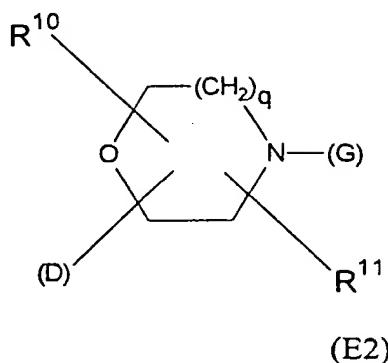
alkylene, especially C₁-C₁₀-alkylene, alkenylene with at least two C-atoms, especially C₂-C₁₀-alkenylene or alkinylene with at least three C-atoms, especially C₃-C₁₀-alkinylene, whereby one to three methylene units are each isostERICALLY replaced by O, S, NR⁹, CO, SO or SO₂ wherein

R⁹ is selected from hydrogen, alkyl, especially C₁-C₆-alkyl, alkenyl, especially C₃-C₆-alkenyl, alkinyl, especially C₃-C₆-alkinyl, acyl, especially C₁-C₆-acyl or alkylsulfonyl, especially C₁-C₆-alkylsulfonyl,

E is selected from



or



wherein the heterocyclic ring can also optionally have a double bond and

n and

p can be, independently of one another, 0, 1, 2 or 3, with the proviso that **n + p** ≤ 4 and

q is 2 or 3,

R¹⁰ is hydrogen, alkyl, especially C₁-C₆-alkyl, hydroxy, hydroxymethyl, carboxy or alkoxy carbonyl with at least two C-atoms, especially C₂-C₇-alkoxy carbonyl and

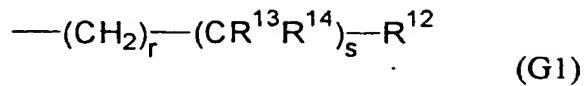
R¹¹ is hydrogen, alkyl, especially C₁-C₆-alkyl or an oxo group adjacent to the nitrogen atom, wherein

R¹⁰ and **R¹¹** optionally together, form an alkylene bridge with 1, 2, 3, 4 or 5 C-atoms, especially a C₁-C₃-alkylene bridge under formation of a bicyclic ring system,

G is selected from hydrogen,

G₁, G₂, G₃, G₄ and G₅, wherein

G₁ represents the residue



wherein

r is an integer from 1 to 3 or 0 and

s is 0 or 1,

R¹² is selected from hydrogen, alkyl, especially C₁-C₆-alkyl, alkenyl with at least three C-atoms, especially C₃-C₆-alkenyl, alkinyl with at least three C-atoms, especially C₃-C₆-alkinyl, cycloalkyl with at least three C-atoms, especially C₃-C₈-cycloalkyl,

saturated, five to seven membered heterocycles, which can contain one or two hetero-atoms from the group N and/or S and/or O,

benzyl or phenyl,

monocyclic aromatic five or six-membered heterocycles, which can contain one to three hetero-atoms from the group N and/or S and/or O and are either bound directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein the linkage can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein one to

three ring atoms can be selected from N and/or S and/or O and the linkage can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

R¹³ has the same meaning as **R¹²**, but is selected independently thereof,

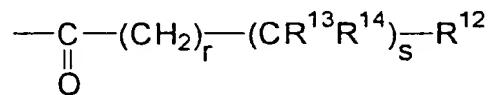
R¹⁴ is selected from hydrogen, hydroxy, methyl, benzyl, phenyl,

monocyclic aromatic five- or six-membered heterocycles, which can contain one to three hetero-atoms selected from the group N and/or S and/or O and are either bound directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein the linkage can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

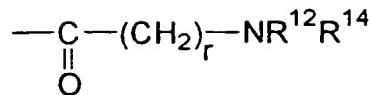
anellated bi- and tricyclic aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein one to three ring atoms can be selected from N and/or S and/or O and the linkage can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

G₂ is the residue



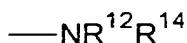
(G_{2a})

or



(G2b)

wherein the substituents R^{12} and R^{14} can have the above meaning or the grouping

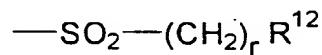


can also be a nitrogen heterocycle bound over the nitrogen atom, selected from

saturated or unsaturated monocyclic, four- to eight-membered heterocycles, which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from the group N and/or S and/or O, or

saturated or unsaturated bi- or tricyclic, anellated or bridged heterocycles with 8 to 16 ring atoms, which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from the group N and/or S and/or O,

G3 is the residue



(G3)

and

G4 is the residue



(G4)

wherein

Ar¹ and **Ar²** are selected independently from one another from phenyl, pyridyl or naphthyl and

G5 is the residue



(G5)

wherein

R¹⁵ is selected from trifluoromethyl, alkoxy, especially C₁-C₆-alkoxy, alkenyloxy, especially C₃-C₆-alkenyloxy, or benzyloxy,

wherein any aryl residues and/or aromatic ring systems in the substituents **R¹, R², R⁴, R¹², R¹³, R¹⁴, R¹⁵, Ar¹ and Ar²** and/or in the ring system -NR¹²R¹⁴ can be substituted independently from each other by one to three of the same or different residues which are selected from halogen, cyano, alkyl, especially C₁-C₆-alkyl, trifluoromethyl, cycloalkyl, especially C₃-C₈-cycloalkyl, phenyl, benzyl, hydroxy, alkoxy, especially C₁-C₆-alkoxy, alkoxy, substituted entirely or partially by fluorine, substituted alkoxy especially C₁-C₆-alkoxy, benzyloxy, phenoxy, mercapto, alkylthio, especially C₁-C₆-alkylthio, carboxy, alkoxycarbonyl, especially C₁-C₆-aloxycarbonyl, benzyloxycarbonyl, nitro, amino, monoalkylamino, especially mono-C₁-C₆-alkylamino, dialkylamino, especially di-(C₁-C₆-alkyl)-amino and methylenedioxy for two adjacent groups on the aromatic ring or ring system,

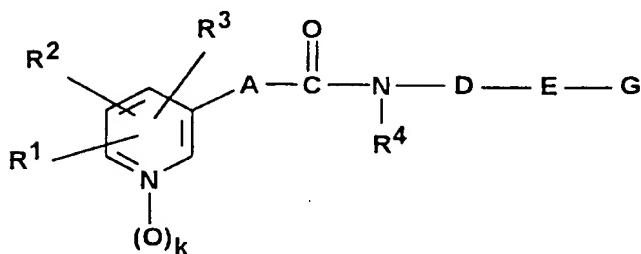
wherein each of the residues alkyl, alkenyl, alkinyl, hydroxyalkyl, alkoxy, alkenyloxy, alkinyloxy, alkanoyloxy, alkoxycarbonyl, alkoxycarbonyloxy, alkylthio, alkenylthio, alkinylthio, alkylene, acyl, alkylsulfonyl, alkenylene, alkinylene, cycloalkyl, cycloalkyloxy, alkoxycarbonyl, alkylaminocarbonyl or dialkylaminocarbonyl of the substituents **R¹** to **R¹³** can have 1 to 2 or 4, 6, 8, 10 or 12 C-atoms and/or 2 or 3 to 5, 7, 9, 11 or 13 and/or 15 C-atoms or 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 or 15 C-atoms depending on the structure, as well as

stereoisomers and/or mixtures thereof and pharmacologically acceptable

acid addition salts thereof

with the exception of (E)-3-(3-pyridyl)-N-[2-(1-benzylpiperidin-4-yl)ethyl]-2-propenamide hydrochloride.

A preferred embodiment according to the invention relates to compounds of formula (I)



(I)

wherein

R¹ is a hydrogen, halogen, cyano, C₁-C₆-alkyl, C₃-C₆-alkenyl, C₃-C₆-alkinyl, trifluoromethyl, C₃-C₈-cycloalkyl, C₁-C₆-hydroxyalkyl, hydroxy, C₁-C₆-alkoxy, C₃-C₆-alkenyloxy, C₃-C₆-alkinyloxy, benzyloxy, C₁-C₇-alkanoyloxy,

C₂-C₇-alkoxycarbonyloxy, C₁-C₆-alkylthio, C₃-C₆-alkenylthio, C₃-C₆-alkinylthio, C₃-C₈-cycloalkyloxy, C₃-C₈-cycloalkylthio, C₂-C₇-alkoxycarbonyl, aminocarbonyl, C₂-C₇-alkylaminocarbonyl, C₃-C₁₃-dialkylaminocarbonyl, carboxy, phenyl, phenoxy, phenylthio, pyridyloxy, pyridylthio, or NR⁵R⁶, wherein

R⁵ and

R⁶ are selected independently from each other from hydrogen, C₁-C₆-alkyl, C₃-C₆-alkenyl and C₃-C₆-alkinyl,

R² is hydrogen, halogen, cyano, C₁-C₆-alkyl, trifluoromethyl, hydroxy, C₁-C₆-alkoxy, benzyloxy or C₁-C₇-alkanoyloxy,

wherein R¹ and R², in case they are adjacent, optionally form a bridge which is selected from the bridge members

-(CH₂)₄- and -(CH=CH)₂- and -CH₂O-CR⁷R⁸-O-, wherein

R⁷ and

R⁸ are, independently from each other, hydrogen or C₁-C₆-alkyl,

R³ is hydrogen, halogen, C₁-C₆-alkyl, trifluoromethyl or C₁-C₆-hydroxyalkyl and

R⁴ is hydrogen, C₁-C₆-alkyl, C₃-C₆-alkenyl, C₃-C₆-alkinyl, C₃-C₆-cycloalkyl, hydroxy, C₁-C₆-alkoxy or benzyloxy,

k is 0 or 1,

A is C₂-C₆-alkenylene, which is optionally substituted once to three-fold by C₁-C₃-alkyl, hydroxy, C₁-C₃-alkoxy, fluorine, cyano or phenyl,

C₄-C₆- alkadienylene, which is optionally substituted once or twice by C₁-C₃-alkyl, fluorine, cyano or phenyl

1,3,5-hexatrienylene, which is optionally substituted by C₁-C₃-alkyl, fluorine, cyano or phenyl as well as

ethinylene,

D is selected from C₁-C₁₀-alkylene, optionally substituted once or twice by C₁-C₆-alkyl, hydroxy, or C₁-C₆-alkoxy,

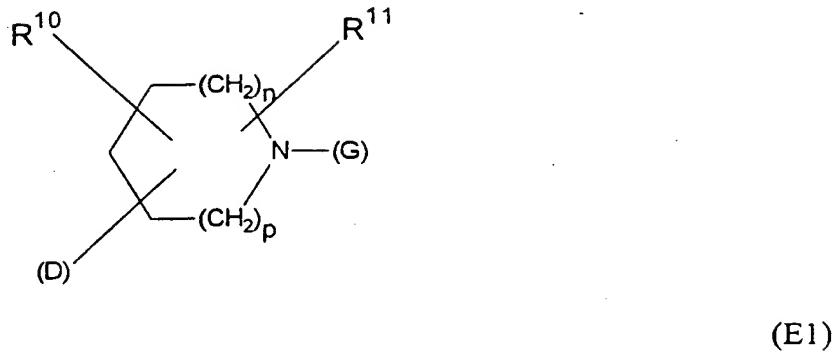
C₂-C₁₀-alkenylene, which is optionally substituted once or twice by C₁-C₆-alkyl, hydroxy, or C₁-C₆-alkoxy, wherein the double bond can also be to ring E,

C₃-C₁₀-alkinylene, optionally substituted once or twice by C₁-C₆-alkyl, hydroxy, or C₁-C₆-alkoxy, and

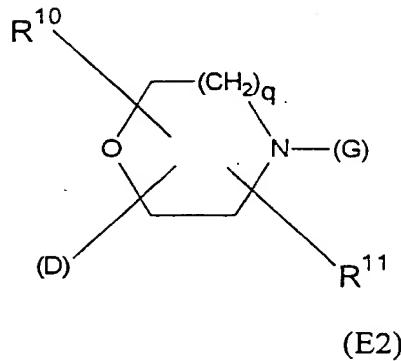
C₁-C₁₀-alkylene, C₂-C₁₀-alkenylene or C₃-C₁₀-alkinylene, wherein one to three methylene units are each isosterically replaced by O, S, NR⁹, CO, SO or SO₂, wherein

R⁹ is selected from hydrogen, C₁-C₆-alkyl, C₃-C₆-alkenyl, C₃-C₆-alkinyl, C₁-C₆-acyl or C₁-C₆-alkylsulfonyl,

E is selected from



or



wherein the heterocyclic ring can optionally have a double bond and

n and

p can be, independently of each other, 0, 1, 2 or 3, with the proviso that n + p ≤ 4
and

q is 2 or 3,

R¹⁰ is hydrogen, C₁-C₆-alkyl, hydroxy, hydroxymethyl, carboxy or C₂-C₇-alkoxycarbonyl and

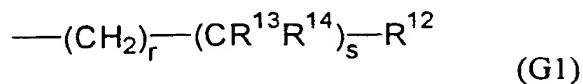
R¹¹ hydrogen, C₁-C₆-alkyl or an oxo group adjacent to the nitrogen atom, wherein

R¹⁰ and **R¹¹** optionally together form a C₁-C₃-alkylene bridge under formation of a bi-cyclic ring system,

G is selected from hydrogen,

G1, G2, G3, G4 and **G5**, wherein

G1 represents the residue



wherein

r is an integer from 1 to 3 or 0 and

s is 0 or 1,

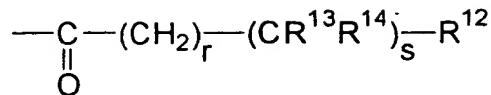
R¹² is selected from hydrogen, C₁-C₆-alkyl, C₃-C₆-alkenyl, C₃-C₆-alkinyl, C₃-C₈-cycloalkyl,

saturated, five- to seven-membered heterocycles, which can contain one or two hetero-atoms from the group N and/or S and/or O,

benzyl or phenyl,

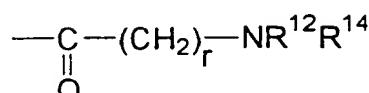
monocyclic aromatic five or six-membered heterocycles, which can contain one to three hetero-atoms from the group N and/or S and/or O and are either bound directly or over a methylene group,

G2 is the residue



(G2a)

or



(G2b)

wherein the substituents R¹² and R¹⁴ can have the above meaning or the grouping



can also be a nitrogen heterocycle bound over the nitrogen atom, selected from

saturated or unsaturated monocyclic, four- to eight-membered heterocycles, which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from the group N and/or S and/or O, or

saturated or unsaturated bi- or tricyclic, anellated or bridged heterocycles with 8 to 16 ring atoms, which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from the group N and/or S and/or O,

G3 is the residue

anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein the linkage can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein one to three ring atoms can be selected from N and/or S and/or O and the linkage can occur either over an aromatic ring or a hydrated ring and either directly or over a methylene group,

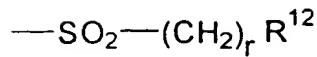
R¹³ has the same meaning as **R¹²**, but is selected independently thereof,

R¹⁴ is selected from hydrogen, hydroxy, methyl, benzyl, phenyl,

monocyclic aromatic five- or six-membered heterocycles, which can contain one to three hetero-atoms selected from the group N and/or S and/or O and are either bound directly or over a methylene group,

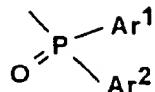
anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein the linkage can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein one to three ring atoms can be selected from N and/or S and/or O and the linkage can occur either over an aromatic ring or a hydrated ring and either directly or over a methylene group,



(G3)

and

G4 is the residue

(G4)

wherein

Ar¹ and **Ar²** are selected independently from one another from phenyl, pyridyl or naphthyl and

G5 is the residue

(G5)

wherein

R¹⁵ is selected from trifluoromethyl, C₁-C₆-alkoxy, C₃-C₆-alkenyloxy, or benzyloxy, and wherein

aromatic ring systems in the substituents **R¹, R², R⁴, R¹², R¹³, R¹⁴, R¹⁵, Ar¹ and Ar²** and/or in the ring system -NR¹²R¹⁴ can be substituted independently from each other by one to three of the same or different residues which are selected from halogen, cyano, C₁-C₆-alkyl, trifluoromethyl, C₃-C₈-cycloalkyl, phenyl, benzyl, hydroxy, C₁-C₆-alkoxy, which can optionally be entirely or partially substituted by fluorine, benzyloxy, phenoxy, mercapto, C₁-C₆-alkylthio, carboxy, C₁-C₆-alkoxycarbonyl,

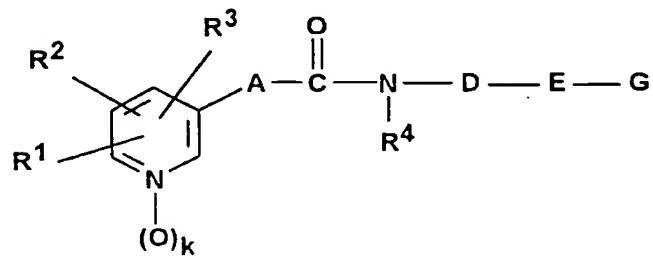
benzyloxycarbonyl, nitro, amino, mono-C₁-C₆-alkylamino or di-(C₁-C₆-alkyl)-amino and methylenedioxy for two adjacent groups on the aromatic ring or ring system,

stereoisomers thereof and/or mixtures thereof and pharmacologically acceptable

acid addition salts

with the exception of (E)-3-(3-pyridyl)-N-[2-(1-benzylpiperidin-4-yl)ethyl]-2-propenamide hydrochloride.

A further preferred embodiment of the invention constitutes compounds of the invention, which are distinguished in that substituents R¹, R², R³, R⁴, R⁵, R⁶, R⁷, R⁸, R⁹, R¹², R¹³, R¹⁴ and R¹⁵ as well as A and D labelled therein have the following meaning in connection with the given substitutions according to this formula



(I)

wherein

halogen is fluorine, chlorine, bromine or iodine,

C₁-C₆-alkyl can be straight chain or branched and is preferably a methyl-, ethyl-, propyl-, isopropyl-, butyl-, isobutyl-, sec-butyl-, tert-butyl-, cyclopropylmethyl-, pentyl-, isopentyl-, tert-pentyl-, neopentyl-, cyclopropylethyl-, cyclobutylmethyl- or a hexyl group,

alkylene is for example methylene, ethylene, propylene, tetramethylene, pentamethylene, hexamethylene, heptamethylene, octamethylene, nonamethylene or decamethylene,

C₃-C₆-alkenyl can be straight chain or branched and is preferably an allyl-, 2-but enyl-, 3-but enyl-, 2-methyl-2-propenyl-, 2-pentenyl-, 4-pentenyl-, 2-methyl-2-but enyl-, 3-methyl-2-but enyl-, 2-hexenyl-, 5-hexenyl-, 4-methyl-3-pentenyl- or 2,2-dimethyl-3-but enyl group,

alkenylene is for example ethenylene, propenylene, butenylene, pentenylene, hexenylene, hexathenylene, heptenylene, octenylene, nonenylene or decenylene,

C₃-C₆-alkinyl can be straight chain or branched and is preferably a propargyl-, 2-but inyl-, 3-but inyl-, 4-pentinyl-, 5-hexinyl- or 4-methyl-2-pentinyl group,

alkinylene is for example propinylene, butinylene, pentinylene, hexinylene, heptinylene, octinylene, noninylene or decinylene,

C₃-C₈-cycloalkyl is preferably cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl or cyclooctyl,

C₁-C₆-hydroxyalkyl contains a hydroxyl group in one of the above-named C₁-C₆-alkyl residues, especially in the form of the hydroxymethyl- and hydroxyethyl group, wherein

C₁-C₆-alkoxy, **C₃-C₆-alkenyloxy**, **C₃-C₆-alkinyloxy** each contain, aside from the oxygen atom, one of the C₁-C₆-alkyl-, C₃-C₆-alkenyl- and/or C₃-C₆-alkinyl groups named above and the methoxy-, ethoxy-, isopropoxy-, tert-butoxy-, allyloxy- and propargyloxy group are preferred and is to be understood as among C₁-C₆-alkoxy

entirely or partially substituted with fluorine, for example difluormethoxy, trifluormethoxy or 2,2,2-trifluorethoxy,

C₁-C₆-alkylthio, C₃-C₆-alkenylthio, C₃-C₆-alkinylthio each contain, aside from the sulfur atom, one of the C₁-C₆-alkyl-, C₃-C₆-alkenyl- or C₃-C₆-alkinyl group named above, especially the methylthio-, ethylthio-, isopropylthio- and tert-butylthio groups,

C₃-C₈-cycloalkyloxy and **C₃-C₈-cycloalkylthio** are preferred as cyclopentyloxy- and cyclopentylthio- and/or cyclohexyloxy- and cyclohexylthio groups,

C₁-C₇-alcanoxyloxy groups contain, aside from the oxygen atom, an aliphatic acyl residue with 1 to 7 carbon atoms, especially the acetoxy-, propionyloxy- and pivaloxyloxy group,

C₂-C₇-alkoxycarbonyl groups contain, aside from the carbonyl group, one of the C₁-C₆-alkoxy groups mentioned above, especially the methoxycarbonyl-, ethoxycarbonyl-, isopropoxycarbonyl-, isobutoxycarbonyl-and tert-butoxycarbonyl group,

C₂-C₇-alkoxycarbonyloxy groups contain, aside from the oxygen atom, one of the C₂-C₇-alkoxycarbonyl residues mentioned above, especially the methoxycarbonyloxy-, ethoxycarbonyloxy-, isopropoxycarbonyloxy-, isobutoxycarbonyloxy-and tert-butoxycarbonyl group as well as the allyloxycarbonyloxy group,

C₂-C₇-alkylaminocarbonyl and **C₃-C₁₃-dialkylaminocarbonyl groups** contain, beside the carbonyl group, an alkylamino- and/or dialkylamino residue, whose C₁-C₆-alkyl groups have the above meanings, wherein the dimethylaminocarbonyl-, diethylaminocarbonyl- and the diisopropylaminocarbonyl groups are preferred, and

aside from the unsubstituted amino group, one of the following C₁-C₆-alkylamino groups and/or di-(C₁-C₆-alkyl)amino groups are to be understood under the amino groups of the formula NR⁵R⁶,

C₁-C₆-alkylamino contains one of the C₁-C₆-alkyl groups mentioned above, especially in form of the methylamino-, ethylamino-, propylamino-, isopropylamino-, butylamino- and the tert-butylamino group,

di-(C₁-C₆-alkyl)amino carries two of the same or different of the above named C₁-C₆-alkyl groups on the nitrogen atom, especially in form of the dimethylamino-, diethylamino-, dipropylamino-, diisopropylamino-, isopropylmethylamino-, dibutylamino- or tert-butylmethylamino group,

C₁-C₆-acyl is the residue of an aliphatic saturated or unsaturated, straight chain, branched or cyclic carboxylic acid, especially in form of the formyl-, acetyl-, propionyl-, acryloyl-, butyryl-, isobutyryl-, methacryloyl-, cyclopropylcarbonyl-, pentanoyl-, pivaloyl-, cyclobutylcarbonyl-, hexanoyl- and the dimethylacryloyl group,

C₁-C₆-alkansulfonyl is preferably the methanesulfonyl-, ethanesulfonyl-, propanesulfonyl-, butanesulfonyl-, pentanesulfonyl- and the hexanesulfonyl group,

saturated five- to seven-membered heterocycles with one or two hetero-atoms are especially tetrahydrofuryl, tetrahydrothienyl, pyrrolidinyl, tetrahydropyranyl, piperidinyl, hexahydroazepinyl, piperazinyl, hexahydrodiazepinyl or morpholinyl,

monocyclic aromatic five- or six-membered heterocycles with one to three hetero-atoms are especially furyl, thienyl, pyrrolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, imidazolyl, pyrazolyl, oxadiazolyl, thiadiazolyl, triazolyl, pyridyl, pyrazinyl, pyridazinyl, pyrimidinyl or triazinyl,

anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring are preferably benzocyclobutyl, indanyl, indenyl, naphthyl, dihydronaphthyl, tetrahydronaphthyl, biphenylenyl, fluorenyl, anthryl, dihydroanthryl, phenanthryl, dihydrophenanthryl, dibenzocycloheptenyl, dihydridobenzocycloheptenyl, dihydridobenzocyclooctenyl or tetrahydridobenzocyclooctenyl, wherein mono- or dioxo-derivates, wherein the residues of indanone, tetralone, anthrone, anthraquinone, fluorenone, phenanthrone, dibenzocycloheptenone, dihydridobenzocycloheptenone or tetrahydridobenzocyclooctenone are for example also to be understood as partially hydrated carbocyclic ring systems,

anellated bi- and tricyclische aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring are, for example, imidazothiazolyl, benzofuryl, dihydrobenzofuryl, benzothienyl, dihydrobenzothienyl, indolyl, indolinyl, benzimidazolyl, indazolyl, benzoxazolyl, benzisoxazolyl, benzo-thiazolyl, benzoisothiazolyl, benzofurazanyl, benzothiadiazolyl, benzotriazolyl, oxazolopyridyl, thiazolopyridyl, isothiazolopyridyl, imidazopyridyl, pyrazolopyridyl, thienopyrimidinyl, chromanyl, benzopyranyl, quinolyl, isoquinolyl, dihydroquinolyl, tetrahydroquinolyl, benzodioxanyl, quinoxaliny, quinazolinyl, naphthyridinyl, carbazolyl, tetrahydrocarbazolyl, pyridoindolyl, acridinyl, phenothiazinyl, dihydridobenzoxepinyl, benzocycloheptathienyl, dihydrothienobenzothiepinyl, dihydridobenzothiepinyl, octahydrodibenzothiepinyl, dihydridobenzazepinyl, octahydrodibenzazepinyl, benzocycloheptapyridyl, dihydropyridobenzodiazepinyl, dihydridobenzoxazepinyl, dihydropyridobenzoxepinyl, dihydropyridobenzoxazepinyl, dihydridobenzothiazepinyl or dihydropyridobenzothiazepinyl, wherein their mono- or dioxo-derivates and/or optionally their possible tautomeres are also to be understood as partially hydrated heterocyclic ring systems, for example, the residues of indolinone, isatin, benzoxazolone and/or its tautomeres hydroxybenzoxazol, of benzisoxazolone, benzothiazolone, benzoisothiazolone and benzimidazolone and/or their tautomeres, hydroxybenzisoxazol, hydroxybenzothiazol, hydroxybenzoisothiazol and

hydroxybenzimidazol, of indazolinone, of oxazolopyridinone, thiazolopyridinones, pyrazolopyridinones and imidazopyridinones and/or their tautomeres hydroxyoxazolopyridine, hydroxythiazolopyridines, hydroxypyrazolopyridines and hydroxyimidazopyridines, the residues of chromanone, chromone, quinolinone, dihydroquinolinone, tetrahydrocarbazolone, acridone, of dihydrotetrahydrobenzoxepinones, benzocycloheptathiophenones, dihydrothienobenzothiepinones, dihydrotetrahydrothiepinones, dihydrotetrahydrobenzoazepinones, benzocycloheptapyridinones, dihydropyrido-benzoxazepinones, dihydrotetrahydrobenzothiazepinones and of dihydrotetrahydrobenzothiazepinones,

saturated and unsaturated monocyclic, four- to eight-membered heterocycles

represent $\text{—NR}^{12}\text{R}^{14}$ as a grouping which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from N and/or S and/or O, for example azetidine, pyrrolidine, piperidine, (1H)tetrahydropyridine, hexahydroazepine, (1H)tetrahydroazepine, octahydroazocine, pyrazolidine, piperazine, hexahydrodiazepine, morpholine, hexahydrooxazepine, thiomorpholine or thiomorpholine-1,1-dioxide,

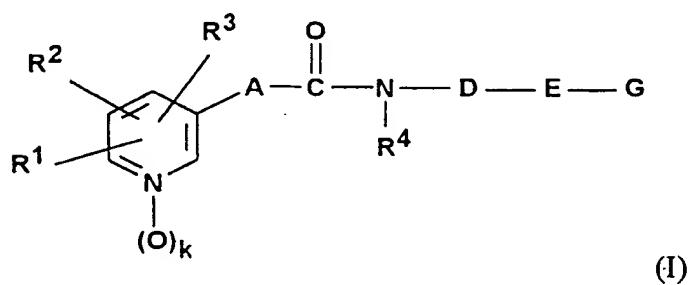
saturated or unsaturated bi- or tricyclic, anellated or bridged heterocycles with 8 to 16 ring atoms, represent $\text{—NR}^{12}\text{R}^{14}$ as a grouping which, aside from the essential nitrogen atom optionally contain one or two further hetero-atoms, selected from N and/or S and/or O, for example 5-aza-bicyclo[2.1.1]hexane, 2-aza-bicyclo[2.2.1]heptane, 7-aza-bicyclo[2.2.1]heptane, 2,5-diaza-bicyclo[2.2.1]heptane, 2-aza-bicyclo[2.2.2]octane, 8-aza-bicyclo[3.2.1]octane, 2,5-diaza-bicyclo[2.2.2]octane, 9-aza-bicyclo[3.3.1]nonane, indoline, isoindoline, (1H)-dihydroquinoline, (1H)-tetrahydroquinoline, (2H)-tetrahydroisoquinoline, (1H)-tetrahydroquinoxaline, (4H)-dihydrobenzoxazine, (4H)-dihydrobenothiazine, (1H)-tetrahydrobenzo[b]azepine, (1H)-tetrahydrobenzo[c]azepine, (1H)-tetrahydrobenzo[d]azepine, (5H)-tetrahydrobenzo[b]oxazepine, (5H)-tetrahydrobenzo[b]thiazepine, 1,2,3,4-tetrahydro-9H-pyrido[3,4-b]indol, (10H)-dihydroacridine, 1,2,3,4-tetrahydroacridanone, (10H)-phenoxazin,

(10H)-phenothiazine, (5H)-dibenzazepine, (5H)-dihydrodibenzazepine, (5H)-octahydrodibenzazepine, (5H)-dihydrodibenzodiazepine, (11H)-dihydrodibenz[b,e]oxazepine, (11H)-dihydrodibenz[b,e]thiazepine, (10H)-dihydro-dibenzo[b,f]oxazepine, (10H)-dihydrodibenzo[b,f]thiazepine or (5H)-tetrahydrodibenzazocine, as well as typical

tautomeres in the case of substitution of the heterocycle as such or in an anellated ring system by free hydroxy-, mercapto- and/or amino groups, and

stereoisomers such as, if applicable, cis/trans-isomers, endo/exo-isomers, optic isomers such as enantiomers, diastereomers as pure isomers or mixtures and/or racemic mixtures as well as the pharmacologically acceptable acid addition salts with inorganic or organic acids, wherein the hydrochlorides, hydrobromides, hydroiodides, sulfates and phosphates, are preferred as addition salts with suitable inorganic acids and acetates, benzoates, citrates, fumarates, gluconates, malates, maleates, methanesulfonates, lactates, oxalates, succinates, tartrates and tosylates are preferred as addition salts of organic acids.

Compounds in which the substituents labelled in formula (I)



have the following meanings, are especially preferred:

R¹ is hydrogen, halogen, cyano, C₁-C₆-alkyl, trifluoromethyl, C₃-C₈-cycloalkyl, C₁-C₄-hydroxyalkyl, hydroxy, C₁-C₄-alkoxy, benzyloxy, C₁-C₄-alkanoyloxy,

C₁-C₄-alkylthio, C₂-C₅-alkoxycarbonyl, aminocarbonyl, C₃-C₉-dialkylaminocarbonyl, carboxy, phenyl, phenoxy, pyridyloxy or NR⁵R⁶, wherein

R⁵ and

R⁶ are selected independently from each other from hydrogen and C₁-C₆-alkyl,

R² is hydrogen, halogen, C₁-C₆-alkyl, trifluoromethyl or hydroxy, wherein

R¹ and R², in the case they are adjacent, optionally form a bridge which are selected from the group of bridge members -(CH₂)₄- and -(CH=CH)₂- and -CH₂O-CR⁷R⁸-O-, wherein

R⁷ and

R⁸ can be, independently from each other, hydrogen and C₁-C₆-alkyl,

R³ is selected from hydrogen, halogen and C₁-C₆-alkyl and

R⁴ is selected from hydrogen, C₁-C₆-alkyl, C₃-C₆-alkenyl, hydroxy, C₁-C₆-alkoxy and benzyloxy,

k is 0 or 1,

A is C₂-C₆-alkenylene, which is optionally substituted one to three-fold by C₁-C₃-alkyl, hydroxy, fluorine, cyano, or phenyl,

C₄-C₆-alkadienylene, which is optionally substituted once or twice by C₁-C₃-alkyl, fluorine, cyano, or phenyl,

1,3,5-hexatrienylene, which is optionally substituted by C₁-C₃-alkyl, fluorine, or cyano, as well as

ethinylene

D is selected from C₁-C₁₀-alkylene, which is optionally substituted once or twice by C₁-C₃-alkyl or hydroxy,

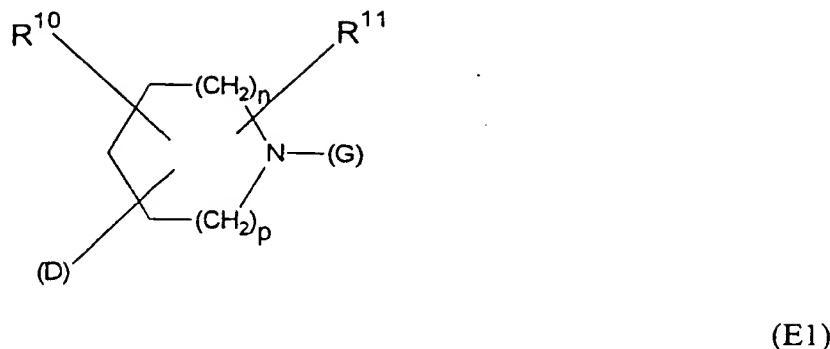
C₂-C₁₀-alkenylene, optionally substituted once or twice by C₁-C₃-alkyl or hydroxy, wherein the double bond can also be to ring E or

C₃-C₁₀-alkinylene, which is optionally substituted once or twice by C₁-C₃-alkyl or hydroxy, and can be selected as well from

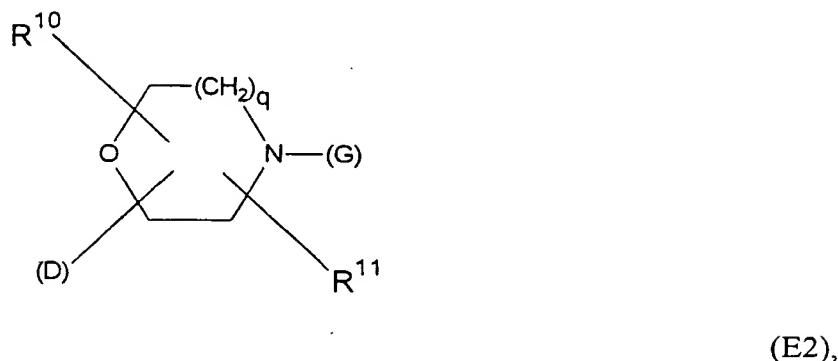
C₁-C₁₀-alkylene, C₂-C₁₀-alkenylene or C₃-C₁₀-alkinylene, in which one to three methylene units are isosterically replaced by O, S, NR⁹, CO, SO or SO₂, wherein

R⁹ is hydrogen, C₁-C₃-alkyl, C₁-C₆-acyl or methanesulfonyl,

E is



or



wherein the heterocyclic ring can optionally have a double bond and

n and **p** can be, independent of each other, 0, 1, 2 or 3, with the proviso that **n** + **p** ≤ 4,

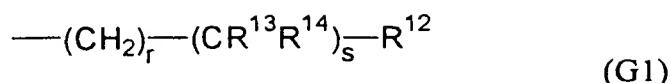
(**q** is 2 or 3,

R¹⁰ is selected from hydrogen, C₁-C₃-alkyl, hydroxy, hydroxymethyl, carboxy or C₂-C₇-alkoxycarbonyl and

R¹¹ is selected from hydrogen or an oxo group adjacent to the nitrogen atom,

G is selected from hydrogen,
G1, **G2**, **G3**, **G4** and **G5**, wherein

G1 represents the residue



wherein

r is 0, 1 or 2 and

s is 0 or 1,

R¹² is selected from hydrogen, C₁-C₆-alkyl, C₃-C₆-alkenyl, C₃-C₆-alkinyl, C₃-C₈-cycloalkyl,

benzyl, phenyl,

monocyclic aromatic five- or six-membered heterocycles, which contain one to three hetero-atoms from the group N and/or S and/or O and are either bound directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, whereby the bond can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein one to three ring atoms can be selected from the groups N and/or S and/or O and the

bond can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

R¹³ has the same meaning as **R¹²**, but is selected independently thereof,

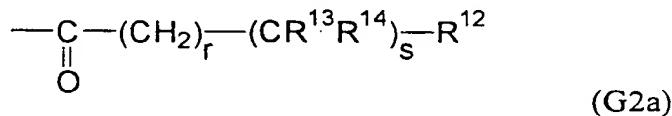
R¹⁴ is selected from hydrogen, hydroxy, methyl, benzyl or phenyl,

monocyclic aromatic five- or six-membered heterocycles, which can contain one to three hetero-atoms selected from the group N and/or S and/or O and are bound either directly or over a methylene group,

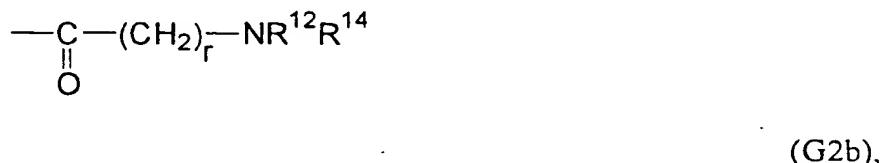
anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein the bond can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein one to three ring atoms can be selected from the group N and/or S and/or O and the bond can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

G2 is selected from the residues



and



wherein the substituents R^{12} and R^{14} can have the above meaning, or the grouping

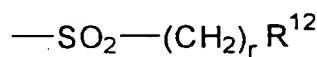


can also be a nitrogen heterocycle bound over the nitrogen atom, selected from

saturated or unsaturated monocyclic, four- to eight-membered heterocycles, which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from N and/or S and/or O, or

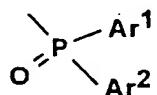
saturated or unsaturated bi- or tricyclic, anellated or bridged heterocycles with 8 to 16 ring atoms, which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from N and/or S and/or O,

G3 is the residue



(G3),

G4 is the residue



(G4),

wherein

Ar^1 and

Ar² are selected independently of each other from phenyl, pyridyl or naphthyl,

G5 is the residue

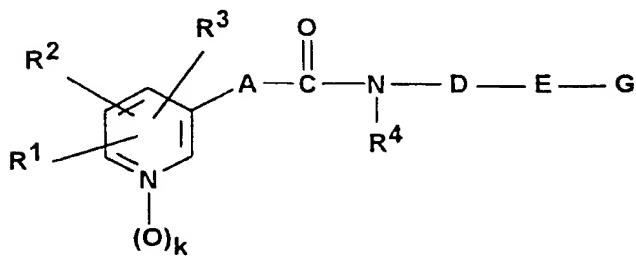
—COR¹⁵
(G5)

wherein

R¹⁵ is trifluoromethyl, C₁-C₆-alkoxy, C₃-C₆-alkenyloxy or benzyloxy and

aromatic ring systems in which the substituents **R¹, R², R⁴, R¹², R¹³, R¹⁴, R¹⁵, Ar¹ and Ar² and/or in the ring system -NR¹²R¹⁴ can carry independently of each other one to three of the same or different substituents from the series halogen, cyano, C₁-C₆-alkyl, trifluoromethyl, C₃-C₈-cycloalkyl, phenyl, benzyl, hydroxy, C₁-C₆-alkoxy, which can be optionally entirely or partially substituted by fluorine, benzyloxy, phenoxy, mercapto, C₁-C₆-alkylthio, carboxy, C₁-C₆-alkoxycarbonyl, benzyloxycarbonyl, nitro, amino, mono-C₁-C₆-alkylamino, di-(C₁-C₆-alkyl)-amino, wherein two adjacent groups on the aromatic ring or ring system can form an additional ring over a methylenedioxy bridge.**

Compounds in which the substituents labelled in formula (I)



(I)

have the following meanings are particularly preferred:

R¹ is hydrogen, halogen, cyano, methyl, trifluoromethyl, hydroxy, C₁-C₄-alkoxy, ethylthio, methoxycarbonyl, tert-butoxycarbonyl, aminocarbonyl, carboxy, and phenoxy,

R² is hydrogen, halogen, trifluoromethyl or hydroxy,

R³ is hydrogen or halogen,

R⁴ is selected from hydrogen, C₁-C₃-alkyl, hydroxy and C₁-C₃-alkoxy,

k is 0 or 1,

A is C₂-C₆-alkenylene, which is optionally substituted once or twice by C₁-C₃-alkyl, hydroxy or fluorine, or

C₄-C₆-alkadienylene, which is optionally substituted by is C₁-C₃-alkyl or by 1 or 2 fluorine atoms, or

1,3,5-hexatrienylene, which is optionally substituted by fluorine, as well as

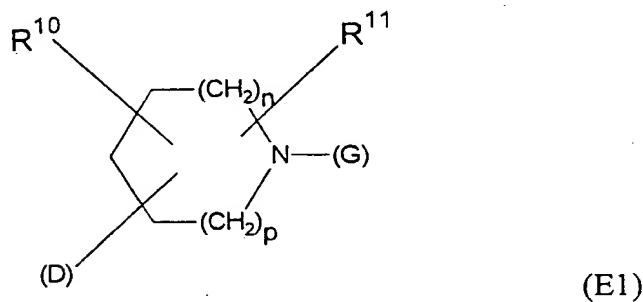
D is C₁-C₈-alkenylene, which is optionally substituted once twice by methyl or hydroxy,

C₂-C₈-alkenylene, which is optionally substituted once or twice by methyl or hydroxy, wherein the double bond can also be to ring E,

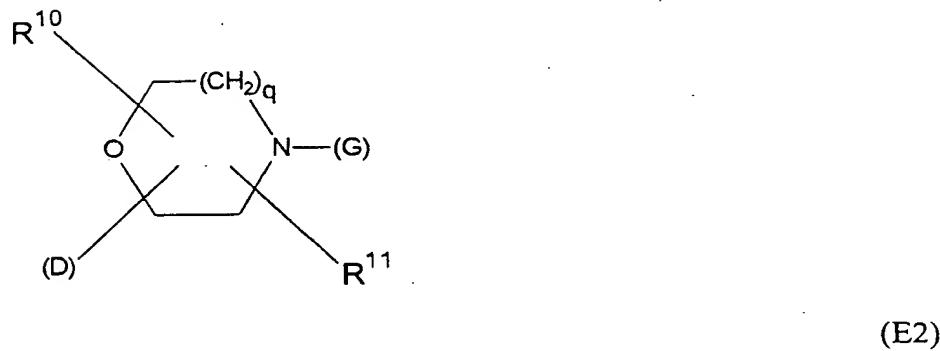
C_3 - C_8 -alkinylene, which is optionally substituted once or twice by methyl or hydroxy, as well as

C_1 - C_8 -alkylene, C_2 - C_8 -alkenylene or C_3 - C_8 -alkinylene, in which one to three methylene units can be isosterically replaced by O, S, NH, N(CH_3), N($COCH_3$), N(SO_2CH_3), CO, SO or SO_2 ,

E is



or



wherein the heterocyclic ring can optionally have a double bond and

n and

p can be independent of each other 0, 1, 2 or 3, with the proviso that $n + p \leq 3$,

q is 2 or 3,

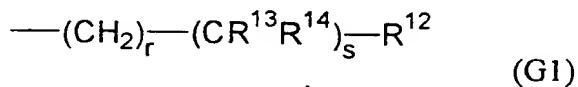
R¹⁰ is selected from hydrogen, C₁-C₃-alkyl, hydroxy, hydroxymethyl and

R¹¹ is selected from hydrogen or an oxo group which is adjacent to the nitrogen atom,

G is hydrogen or

G1, G2, G3, G4 and G5, wherein)

G1 represents the residue



wherein

r is 0, 1 or 2 and

s is 0 or 1,

R¹² is selected from hydrogen, C₁-C₆-alkyl, C₃-C₈-cycloalkyl, benzyl or phenyl,

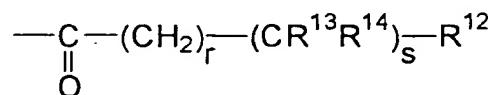
benzocyclobutyl, indanyl, indenyl, oxoindanyl, naphthyl, dihydronaphthyl, tetrahydronaphthyl, oxotetrahydronaphthyl, biphenylenyl, fluorenyl, oxofluorenyl, anthryl, dihydroanthryl, oxodihydroanthryl, dioxodihydroanthryl, phenanthryl, dihydrophenanthryl, oxodihydrophenanthryl, dibenzocycloheptenyl, oxodibenzocycloheptenyl, dihydrodibenzocycloheptenyl, oxodihydrodibenzocycloheptenyl, dihydrodibenzocyclooctenyl, tetrahydrodibenzocyclooctenyl and oxotetrahydrodibenzocyclooctenyl, bound directly or over a methylene group,

furyl, thienyl, pyrrolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, pyrazolyl, imidazolyl, oxadiazolyl, thiadiazolyl, triazolyl, pyridyl, pyrazinyl, pyridazinyl, pyrimidinyl, triazinyl, imidazothiazolyl, benzofuryl, dihydrobenzofuryl, benzothienyl, dihydrobenzothienyl, indolyl, indolinyl, oxoindolinyl, dioxoindolinyl, benzoxazolyl, oxobenzoxazolinyl, benzisoxazolyl, oxobenzisoxazolinyl, benzothiazolyl, oxobenzthiazolinyl, benzoisothiazolyl, oxobenzoisothiazolinyl, benzimidazolyl, oxobenzimidazolinyl, indazolyl, oxoindazolinyl, benzofurazanyl, benzothiadiazolyl, benzotriazolyl, oxazolopyridyl, oxodihydrooxazolopyridyl, thiazolopyridyl, oxodihydrothiazolopyridyl, isothiazolopyridyl, imidazopyridyl, oxodihydroimidazopyridyl, pyrazolopyridyl, oxodihydropyrazolopyridyl, thienopyrimidinyl, chromanyl, chromanonyl, benzopyranyl, chromonyl, quinolyl, isoquinolyl, dihydroquinolyl, oxodihydroquinolinyl, tetrahydroquinolyl, oxotetrahydroquinolinyl, benzodioxanyl, quinoxalinyl, quinazolinyl, naphthyridinyl, carbazolyl, tetrahydrocarbazolyl, oxotetrahydrocarbazolyl, pyridoindolyl, acridinyl, oxodihydroacridinyl, phenothiazinyl, dihydronibenzoxepinyl, oxodihydronibenzoxepinyl, benzocycloheptathienyl, oxobenzocycloheptathienyl, dihydrothienobenzothiepinyl, oxodihydrothienobenzothiepinyl dihydronibenzothiepinyl, oxodihydronibenzothiepinyl, octahydrodibenzothiepinyl, dihydronibenzazepinyl, oxodihydronibenzazepinyl, octahydrodibenzazepinyl, benzocycloheptapyridyl, oxobenzocycloheptapyridyl, dihydropyridobenzodiazepinyl, dihydronibenzoxazepinyl, dihydronibenzoxazepinyl, oxodihydropyridobenzoxazepinyl, dihydronibenzothiazepinyl, oxodihydropyridobenzothiazepinyl, dihydronibenzothiazepinyl, oxodihydropyridobenzothiazepinyl, bound directly or over a methylene group,

R¹³ has the same meaning as R¹², but is selected independently therefrom,

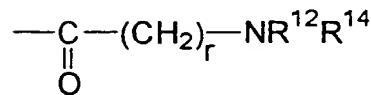
R¹⁴ is selected from hydrogen, hydroxy, methyl, benzyl or phenyl, indanyl, indenyl, naphthyl, dihydronaphthyl, tetrahydronaphthyl, furyl, thienyl, pyrrolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, pyrazolyl, imidazolyl, oxadiazolyl, thiadiazolyl, triazolyl, pyridyl, pyrazinyl, pyridazinyl, pyrimidinyl, triazinyl, benzofuryl, benzothienyl, indolyl, indolinyl, benzoxazolyl, benzothiazolyl, benzimidazolyl, chromanyl, quinolyl or tetrahydroquinolyl bound directly or over a methylene group,

G2 is selected from the residues



(G2a)

and



(G2b)

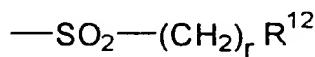
wherein the substituents **R¹²** and **R¹⁴** can have the above meanings, or represents the grouping



over the nitrogen-bound ring atom of azetidine, pyrrolidine, piperidine, (1H)tetrahydropyridine, hexahydroazepine, (1H)tetrahydroazepine, octahydroazocine, pyrazolidine, piperazine, hexahydriediazepine, morpholine, hexahydrooxazepine, thiomorpholine, thiomorpholine-1,1-dioxide, 5-aza-bicyclo[2.1.1]hexane, 2-aza-bicyclo[2.2.1]heptane, 7-aza-bicyclo[2.2.1]heptane,

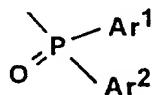
2,5-diaza-bicyclo[2.2.1]heptane, 2-aza-bicyclo[2.2.2]octane, 8-aza-bicyclo[3.2.1]octane, 2,5-diazabicyclo[2.2.2]octane, 9-azabicyclo[3.3.1]nonane, indoline, isoindoline, (1H)-dihydroquinoline, (1H)-tetrahydroquinoline, (2H)-tetrahydroisoquinoline, (1H)-tetrahydroquinoxaline, (4H)-dihydrobenzoxazine, (4H)-dihydrobenzothiazine, (1H)-tetrahydrobenzo[b]azepine, (1H)-tetrahydrobenzo[c]azepine, (1H)-tetrahydrobenzo[d]azepine, (5H)-tetrahydrobenzo[b]oxazepine, (5H)-tetrahydrobenzo[b]thiazepine, 1,2,3,4-tetrahydro-9H-pyrido[3,4-b]indole, (10H)-dihydroacridine, 1,2,3,4-tetrahydroacridanone, (10H)-phenoxyazine, (10H)-phenothiazine, (5H)-dibenzazepine, (5H)-dihydrodibenzazepine, (5H)-Octahydrodibenzazepine, (5H)-dihydrodibenzodiazepine, (11H)-dihydrodibenzo[b,e]oxazepine, (11H)-dihydronbenzo[b,e]thiazepine, (10H)-dihydronbenzo[b,f]oxazepine, (10H)-dihydronbenzo[b,f]thiazepine or (5H)-tetrahydronbenzazocine,

G3 is the residue



(G3),

G4 is the residue



(G4),

wherein

Ar¹ and

Ar² are selected independently of each other from phenyl, pyridyl or naphthyl,

G5 is the residue

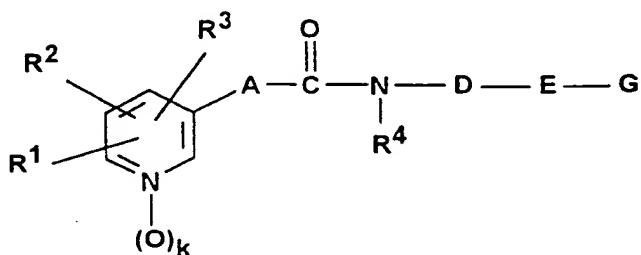
—COR¹⁵
(G5)

wherein

R¹⁵ is trifluoromethyl, C₁-C₆-alkoxy, C₃-C₆-alkenyloxy or benzyloxy and

aromatic ring systems in which the substituents can be substituted independently of each other by one to three of the same or different substituents from the series halogen, cyano, C₁-C₆-alkyl, trifluoromethyl, C₃-C₈-Cycloalkyl, phenyl, benzyl, hydroxy, C₁-C₆-alkoxy, C₁-C₆-alkoxy, which can be entirely or partially substituted by fluorine, can carry benzyloxy, phenoxy, mercapto, C₁-C₆-alkylthio, carboxy, C₁-C₆-alkoxycarbonyl, benzyloxycarbonyl, nitro, amino, mono-C₁-C₆-alkylamino, di-(C₁-C₆-alkyl)-amino, wherein two adjacent groups can form an additional ring with a methylenedioxy bridge.

A further preferred embodiment of the invention is in compounds which are distinguished in that the labelled substituents in formula (I)



(I)

have the following meaning:

R¹ is hydrogen, halogen, cyano, methyl, trifluoromethyl, hydroxy, methoxy or methoxycarbonyl,

R² is hydrogen or halogen,

R³ is hydrogen,

R⁴ is selected from hydrogen, C₁-C₃-alkyl or hydroxy,

k is 0 or 1,

A is selected from C₂-C₆-alkylene, which is optionally substituted once or twice by hydroxy or fluorine, or

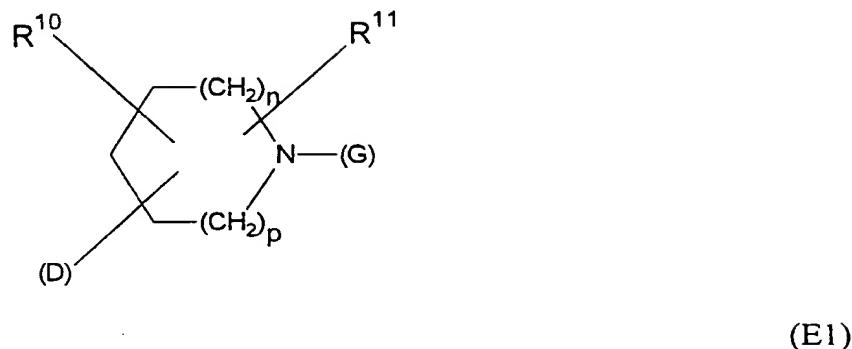
C₂-C₆-alkenylene, which is optionally substituted once or twice by hydroxy or fluorine,

C₄-C₆-alkadienylene, which is optionally substituted by 1 or 2 fluorine atoms,
or

1,3,5-hexatrienylene,

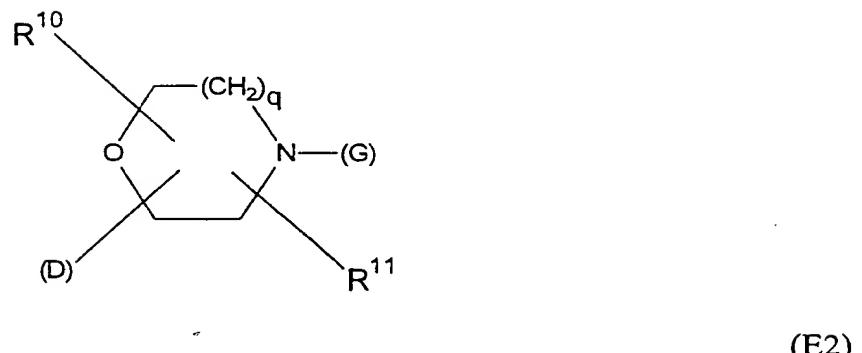
D is C₂-C₈-alkylene, which is optionally substituted by methyl or hydroxy,
C₂-C₈-alkenylene, which is optionally substituted by methyl or hydroxy,
wherein the double bond can also be to ring E, or
C₂-C₈-alkylene, C₂-C₈-alkenylene, wherein one to three methylene units can
be isosterically replaced by O, NH, N(CH₃), N(COCH₃), N(SO₂CH₃) or CO,

E is selected from the residues



(E1)

or



(E2),

wherein the heterocyclic ring can optionally have a double bond and

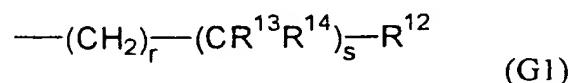
n and p can be, independent of each other, 0, 1, 2 or 3, with the proviso that $n + p \leq 3$
and

q is 2

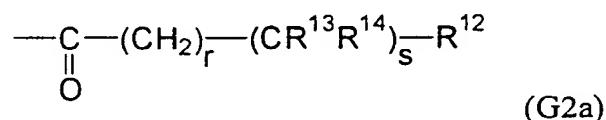
R^{10} is hydrogen, methyl or hydroxyl and

R^{11} is hydrogen or an oxo group adjacent to the nitrogen atom,

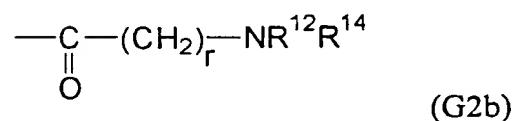
G is selected from hydrogen, C₃-C₈-cycloalkyl, methoxycarbonyl, tert-butoxycarbonyl, benzyloxycarbonyl, trifluoroacetyl, diphenylphosphinoyl or the residues



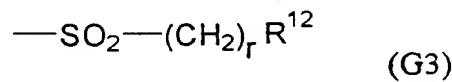
and



and



and



wherein

r is 0, 1 or 2 and

s is 0 or 1,

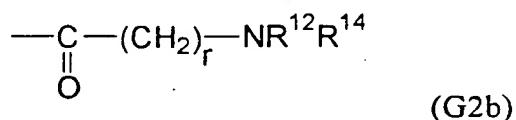
R¹² is hydrogen, methyl, benzyl or phenyl,

indanyl, indenyl, oxoindanyl, naphthyl, dihydronaphthyl, tetrahydronaphthyl, oxotetrahydronaphthyl, fluorenyl, oxofluorenyl, anthryl, dihydroanthryl, oxodihydroanthryl, dioxodihydroanthryl, dibenzocycloheptenyl, oxodibenzocycloheptenyl, dihydridobenzocycloheptenyl, oxodihydridobenzocycloheptenyl bound directly or over a methylene group,

furyl, thienyl, pyrrolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, pyrazolyl, imidazolyl, oxadiazolyl, thiadiazolyl, triazolyl, pyridyl, pyrazinyl, pyridazinyl, pyrimidinyl, imidazothiazolyl, benzofuryl, dihydrobenzofuryl, benzothienyl, dihydrobenzothienyl, indolyl, indolinyl, oxoindolinyl, dioxoindolinyl, benzoxazolyl, oxobenzoxazolinyl, benzisoxazolyl, oxobenzisoxazolinyl, benzothiazolyl, oxobenzthiazolinyl, benzoisothiazolyl, oxobenzoisothiazolinyl, benzimidazolyl, oxobenzimidazolinyl, benzofurazanyl, benzothiadiazolyl, benzotriazolyl, oxazolopyridyl, oxodihydrooxazolopyridyl, thiazolopyridyl, oxodihydrothiazolopyridyl, isothiazolopyridyl, imidazopyridyl, oxodihydroimidazopyridyl, pyrazolopyridyl, thienopyrimidinyl, chromanyl, chromanonyl, benzopyranyl, chromonyl, quinolyl, isoquinolyl, dihydroquinolyl, oxodihydroquinolinyl, tetrahydroquinolyl, oxotetrahydroquinolinyl, benzodioxanyl, quinoxaliny, quinazolinyl, naphthyridinyl, carbazolyl, tetrahydrocarbazolyl, oxotetrahydrocarbazolyl, pyridoindolyl, acridinyl, oxodihydroacridinyl, phenothiazinyl, dihydridobenzoxepinyl, benzocyclohepta-thienyl, oxobenzocycloheptathienyl, dihydrothienobenzothiepinyl, oxodihydrothienobenzothiepinyl dihydridobenzothiepinyl, oxodihydridobenzothiepinyl, dihydridobenzazepinyl, oxodihydridobenzazepinyl, octahydridobenzazepinyl, benzocycloheptapyridyl, oxobenzocycloheptapyridyl, dihydropyridobenzoxepinyl, dihydridobenzothiazepinyl, oxodihydridobenzothiazepinyl bound directly or over a methylene group,

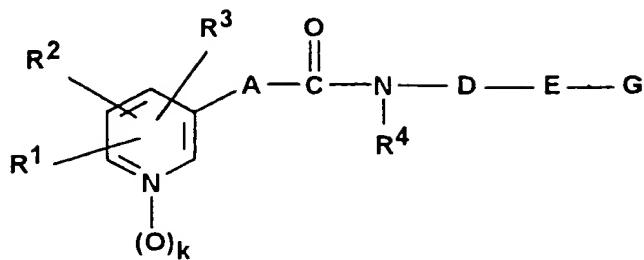
R¹³ is hydrogen, methyl, benzyl or phenyl,

R¹⁴ is selected from hydrogen, hydroxy, methyl, benzyl, phenyl, naphthyl, furyl, thienyl, oxazolyl, thiazolyl, pyrazolyl, imidazolyl, oxadiazolyl, thiadiazolyl, pyridyl, benzofuryl, benzothienyl, indolyl, indolinyl, benzoxazolyl, benzothiazolyl, benzimidazolyl, chromanyl, quinolyl or tetrahydroquinolyl, bound directly or over a methylene group, wherein in formula (I)



-NR¹²R¹⁴ can also be selected from pyrrolidine, piperidine, (1H)tetrahydropyridine, hexahydroazepine, Octahydroazocine, piperazine, hexahydrodiazepine, morpholine, hexahydrooxazepine, 2-azabicyclo[2.2.1]heptane, 7-azabicyclo[2.2.1]heptane, 2,5-diazabicyclo[2.2.1]heptane, 8-azabicyclo[3.2.1]octane, 2,5-diazabicyclo[2.2.2]octane, indoline, isoindoline, (1H)-dihydroquinoline, (1H)-tetrahydroquinoline, (2H)-tetrahydroisoquinoline, (1H)-tetrahydroquinoxaline, (4H)-dihydrobenzoxazine, (4H)-dihydrobenzothiazine, (1H)-tetrahydrobenzo[b]azepine, (1H)-tetrahydrobenzo[d]azepine, (5H)-tetrahydrobenzo[b]oxazepine, (5H)-tetrahydrobenzo[b]thiazepine, 1,2,3,4-tetrahydro-9H-pyrido[3,4-b]indol, (10H)-dihydroacridine, 1,2,3,4-tetrahydroacridanone, (5H)-dihydrodibenzazepine, (5H)-dihydrodibenzodiazepine, (11H)-dihydrodibenzo[b,e]oxazepine, (11H)-dihydrodibenzo[b,e]thiazepine, (10H)-dihydrodibenzo[b,f]oxazepine or (5H)-tetrahydrodibenzazocine.

Compounds in which the labelled substituents in formula (I)



have the following meanings are very particularly preferred:

R¹ is hydrogen, fluorine, chlorine, bromine, methyl, trifluoromethyl or hydroxy,

R² and

R³ are hydrogen,

R⁴ is hydrogen or hydroxy,

k is 0 or 1,

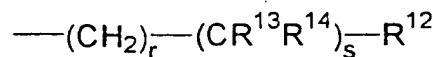
A is selected from C₂-C₄-alkylene, which is optionally substituted by fluorine,

D is selected from C₂-C₆-alkylene, C₂-C₆-alkenylene, wherein the double bond can also be to ring E, and C₂-C₆-alkylene and C₂-C₆-alkenylene, wherein a methylene unit can be isosterically replaced by O, NH, N(CH₃) or CO or an ethylene group can be isosterically replaced by NH-CO and/or CO-NH or a propylene group can be isosterically replaced by NH-CO-O and/or O-CO-NH,

E is selected from pyrrolidine, piperidine, 1,2,5,6-tetrahydropyridine, hexahydroazepine, morpholine and hexahydro-1,4-oxazepine, wherein the

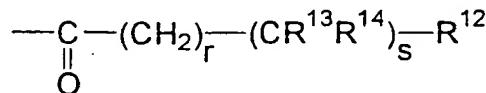
heterocyclic ring optionally adjacent to the nitrogen atom, can be substituted by an oxo group,

G is selected from **hydrogen**, tert-butoxycarbonyl, diphenylphosphinoyl, or one of the residues



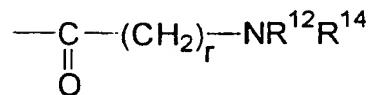
(G1)

and



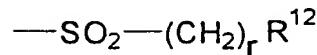
(G2a)

and



(G2b)

and



(G3)

wherein

r is 0 or 1 and**s** is 0 or 1,

R¹² is hydrogen, methyl, benzyl or phenyl,

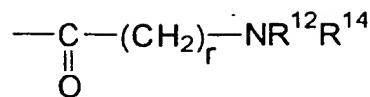
indenyl, oxoindanyl, naphthyl, tetrahydronaphthyl, fluorenyl, oxofluorenyl, anthryl, dihydroanthryl, oxodihydroanthryl, dioxodihydroanthryl, dibenzocycloheptenyl, dihydrodibenzocycloheptenyl bound directly or over a methylene group,

furyl, thienyl, oxazolyl, thiazolyl, imidazolyl, oxadiazolyl, thiadiazolyl, pyridyl, pyrazinyl, pyrimidinyl, imidazothiazolyl, benzofuryl, benzothienyl, indolyl, oxoindolinyl, dioxoindolinyl, benzoxazolyl, oxobenzoxazolinyl, benzothiazolyl, oxobenzthiazolinyl, benzimidazolyl, oxobenzimidazolinyl, benzofurazanyl, benzotriazolyl, oxazolopyridyl, oxodihydrooxazolopyridyl, thiazolopyridyl, oxodihydrothiazolopyridyl, chromanyl, chromanonyl, benzopyranyl, chromonyl, quinolyl, isoquinolyl, oxodihydroquinolinyl, tetrahydroquinolyl, oxotetrahydroquinolinyl, benzodioxanyl, quinazolinyl, acridinyl, oxodihydroacridinyl, phenothiazinyl, dihydronaphthoquinolinyl, benzocycloheptathienyl, dihydrothienobenzothiepinyl, dihydronaphthothiepinyl, oxodihydrobenzothiepinyl, dihydronaphthazepinyl, oxodihydrobenzazepinyl, octahydronaphthazepinyl, benzocycloheptapyridyl, oxobenzocycloheptapyridyl, dihydronaphthothiazepinyl bound directly or over a methylene group,

R¹³ is hydrogen, methyl, benzyl or phenyl,

R¹⁴ is hydrogen, hydroxy, methyl, benzyl or phenyl,

naphthyl, furyl, thienyl, pyridyl, benzofuryl, benzothienyl, indolyl, benzoxazolyl, benzothiazolyl, benzimidazolyl, chromanyl, quinolyl or tetrahydroquinolyl bound directly or over a methylene group, wherein in the formula

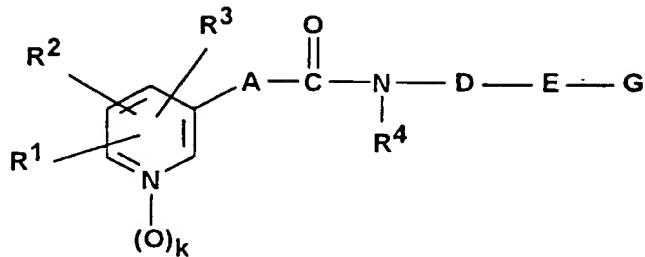


(G2b)

-NR¹²R¹⁴ can be selected from pyrrolidine, piperidine, hexahydroazepine, morpholine, 2,5-diazabicyclo[2.2.1]heptane, indoline, isoindoline, (1H)-dihydroquinoline, (1H)-tetrahydroquinoline, (2H)-tetrahydroisoquinoline, (1H)-tetrahydrobenzo[b]azepine, (1H)-tetrahydrobenzo[d]azepine, (5H)-tetrahydrobenzo[b]oxazepine, (5H)-tetrahydrobenzo[b]thiazepine, 1,2,3,4-tetrahydroacridanone, (5H)-dihydrodibenzazepine, (11H)-dihydrodibenzo[b,e]-oxazepine or (11H)-dihydrodibenzo[b,e]thiazepine and

wherein aromatic ring systems in the substituents can be substituted, independently of each other, by one to three of the same or different substituents from the series halogen, cyano, C₁-C₆-alkyl, trifluoromethyl, C₃-C₈-cycloalkyl, phenyl, benzyl, hydroxy, C₁-C₆-alkoxy, C₁-C₆-alkoxy, which can be entirely or partially substituted by fluorine, can carry benzyloxy, phenoxy, mercapto, C₁-C₆-alkylthio, carboxy, C₁-C₆-alkoxycarbonyl, benzyloxycarbonyl, nitro, amino, mono-C₁-C₆-alkylamino or di-(C₁-C₆-alkyl)-amino, whereby two adjacent groups on the aromatic ring or ring system can form an additional ring over a methylenedioxy bridge.

Compounds are especially preferred which distinguish themselves in that the labelled substituents in formula (I)



have the following meanings:

R¹ is hydrogen, fluorine, methyl, trifluoromethyl or hydroxy,

R² and

R³ are hydrogen,

R⁴ is hydrogen or hydroxy,

k is 0,

A is ethenylene (vinylene) or 1,3-butadienylene,

D is selected from C₂-C₆-alkylene or C₂-C₆-alkenylene, wherein the double bond can also be to ring E,

E is selected from pyrrolidine, piperidine, hexahydroazepine or morpholine,

G is selected from benzyl, phenethyl, fluorenylmethyl, anthrylmethyl, diphenylmethyl, fluorenyl or dihydronaphthalenyl,

furylmethyl, thienylmethyl, thiazolylmethyl, pyridylmethyl, benzothienylmethyl,

quinolylmethyl, phenyl-thienylmethyl, phenyl-pyridylmethyl,
dihydrodibenzoxepinyl, dihydrodibenzothiepinyl,

acetyl, pivaloyl, phenylacetyl, diphenylacetyl, diphenylpropionyl, naphthylacetyl,
benzoyl, naphthoyl, anthrylcarbonyl, oxofluorenycarbonyl, oxodihydro-anthrylcarbonyl or dioxodihydroanthrylcarbonyl,

furoyl, pyridylcarbonyl, chromonylcarbonyl, quinolylcarbonyl,

naphthylaminocarbonyl, dibenzylaminocarbonyl, benzylphenylaminocarbonyl,
diphenylaminocarbonyl, indolinyl-1-carbonyl, dihydrodibenzazepin-N-carbonyl,
tetrahydroquinolinyl-N-carbonyl, tetrahydrobenzo[b]azepinyl-N-carbonyl,

methanesulfonyl, phenylsulfonyl, p-toluenesulfonyl, naphthylsulfonyl,
quinolinsulfonyl and

diphenylphosphinoyl,

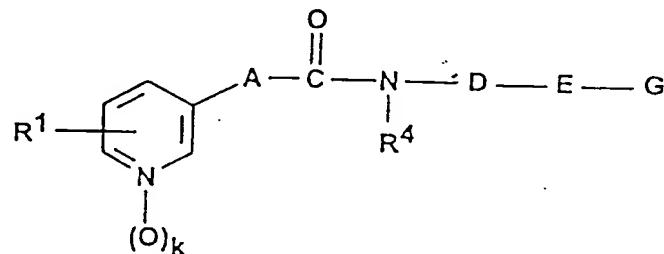
wherein aromatic ring systems can be substituted independently of each other
by one to three of the same or different substituents from the series halogen,
cyano, C₁-C₆-alkyl, trifluoromethyl, C₃-C₈-cycloalkyl, phenyl, benzyl,
hydroxy, C₁-C₆-alkoxy, C₁-C₆-alkoxy, which can be entirely or partially
substituted by fluorine, benzyloxy, phenoxy, mercapto, C₁-C₆-alkylthio,
carboxy, C₁-C₆-alkoxycarbonyl, benzyloxycarbonyl, nitro, amino, mono-C₁-
C₆-alkylamino or di-(C₁-C₆-alkyl)-amino, wherein two adjacent groups in the
ring or ring system can form an additional ring over a methylenedioxy bridge.

A series of exemplary compounds with the respective substituent definitions are listed
in the following Table 1 for illustration of the invention without restricting the scope of
the compounds according to the invention.

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Table 1:

Exemplifying compounds of formula (I) according to the invention



| Nr | R ¹ | k | A | R ⁴ | D-E-G |
|----|----------------|---|-------------|----------------|-------|
| 1 | H | 0 | CH=CH | H | |
| 2 | H | 0 | CH=CH-CH=CH | H | |
| 3 | H | 0 | CH=CH | H | |
| 4 | H | 0 | CH=CH | H | |

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Table 1 (continued)

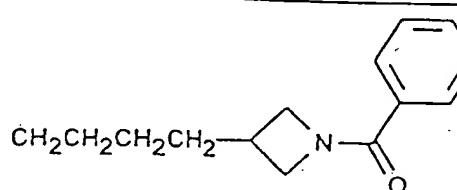
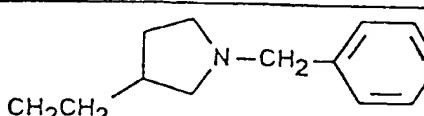
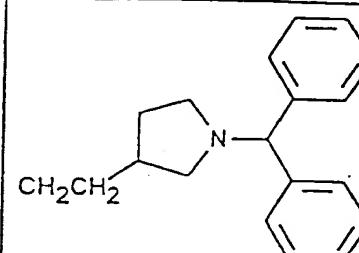
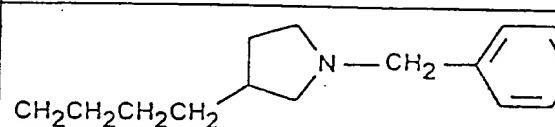
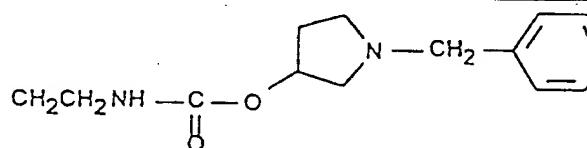
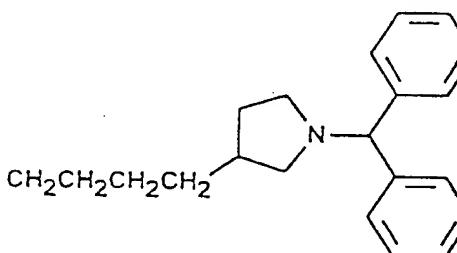
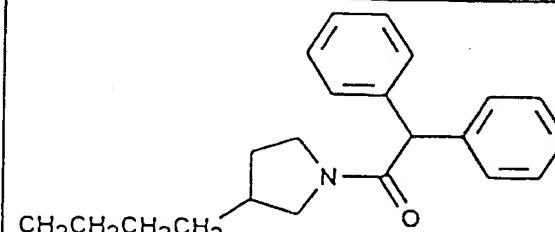
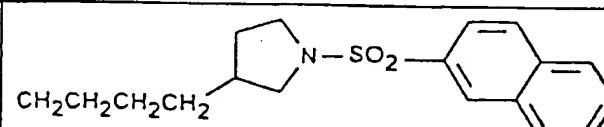
| Nr | R' | k | A | R ⁴ | D-E-G |
|----|----|---|--------------------------------------|----------------|--------------------------------------------------------------------------------------|
| 5 | H | 0 | CH=CH | H |  |
| 6 | H | 0 | CH=CH | H |  |
| 7 | H | 0 | CH=CH-CH=CH | H |  |
| 8 | H | 0 | CH=CH(CH ₂) ₂ | H |  |
| 9 | H | 0 | CH=CH | H |  |
| 10 | H | 0 | CH=CH | H |  |
| 11 | H | 0 | CH=CH | H |  |
| 12 | H | 0 | CH=CH | H |  |

Table 1 (continued)

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| Nr | R' | k | A | R" | D-E-G |
|----|----|---|-----------------|----|-------|
| 13 | H | O | CH=CH | H | |
| 14 | H | O | CH=CH | H | |
| 15 | H | O | CH=CH-CH=CH | H | |
| 16 | H | O | CH=CH | H | |
| 17 | H | O | CH=CH | H | |
| 18 | H | O | CH=CH-CH=CH | H | |
| 19 | H | O | CH=CH-CH=CH | H | |
| 20 | H | O | CH=CH(CH2)2 | H | |
| 21 | H | O | CH=CH | H | |
| 22 | H | O | CH=C CN | H | |
| 23 | H | O | CH=CH | H | |
| 24 | H | O | CH=CH | H | |
| 25 | H | O | CH=CH | H | |

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Table 1 (continued)

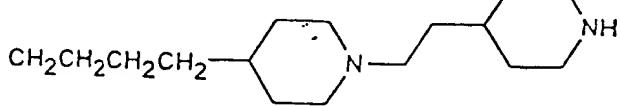
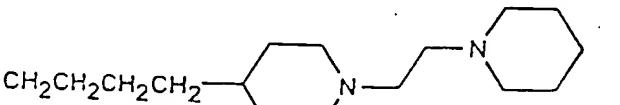
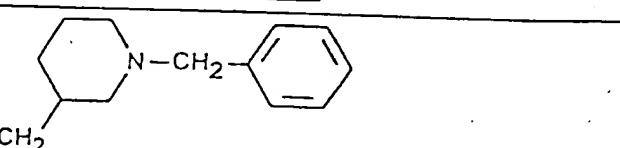
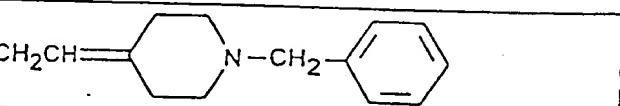
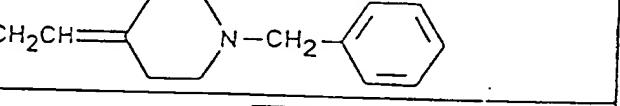
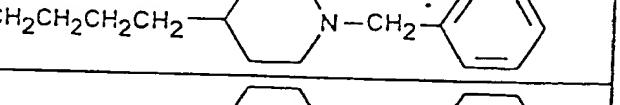
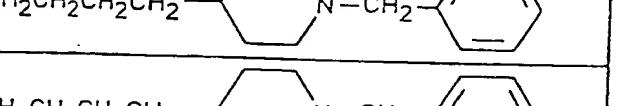
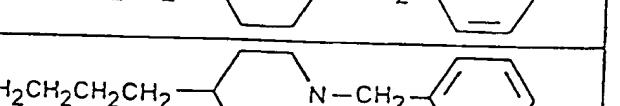
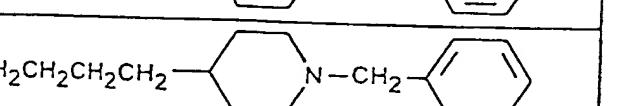
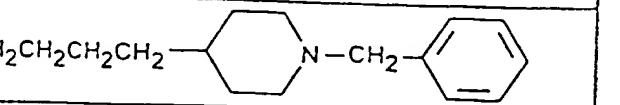
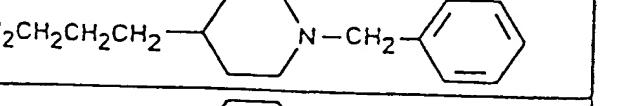
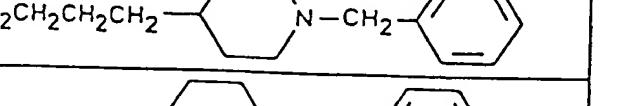
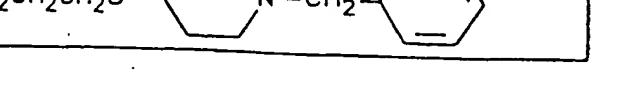
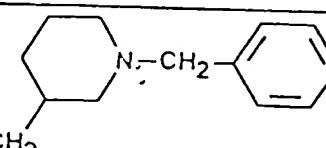
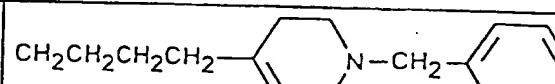
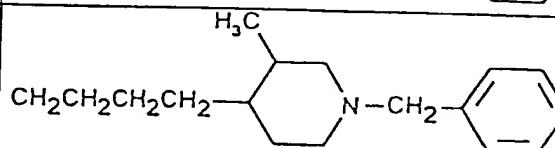
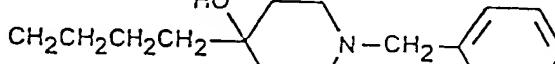
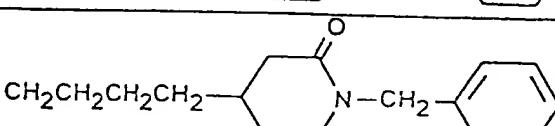
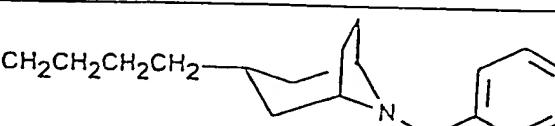
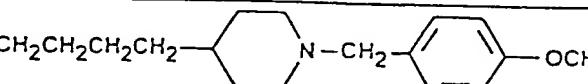
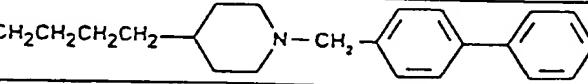
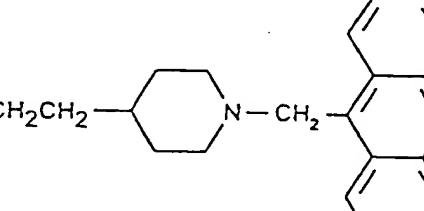
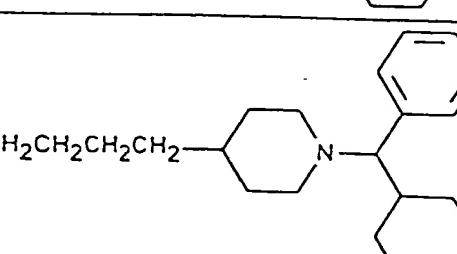
| Nr | R' | k | A | R ⁴ | D-E-G |
|----|-----|---|--------------------------------------|----------------|--------------------------------------------------------------------------------------|
| 26 | H | 0 | CH=CH | H |  |
| 27 | H | 0 | CH=CH | H |  |
| 28 | H | 0 | CH=CH | h |  |
| 29 | H | 0 | CH=CH | H |  |
| 30 | H | 0 | CH=CH-CH=CH | H |  |
| 31 | H | 1 | CH=CH | H |  |
| 32 | H | 0 | CH=CH | OH |  |
| 33 | H | 0 | CH=C CN | H |  |
| 34 | H | 0 | C≡C | H |  |
| 35 | H | 0 | CH=CH(CH ₂) ₂ | H |  |
| 36 | H | 0 | CH=CH-CH=CH | H |  |
| 37 | 2-F | 0 | CH=CH-CH=CH | H |  |
| 38 | H | 0 | (CH=CH) ₃ | H |  |
| 39 | H | 0 | CH=CH | H |  |

Table 1 (continued)

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| Nr | R ¹ | k | A | R ⁴ | D-E-G |
|----|----------------|---|-------------|----------------|--------------------------------------------------------------------------------------|
| 40 | H | 0 | CH=CH | H |  |
| 41 | H | 0 | CH=CH | H |  |
| 42 | H | 0 | CH=CH | H |  |
| 43 | H | 0 | CH=CH | H |  |
| 44 | H | 0 | CH=CH | H |  |
| 45 | H | 0 | CH=CH | H |  |
| 46 | H | 0 | CH=CH-CH=CH | H |  |
| 47 | H | 0 | CH=CH-CH=CH | H |  |
| 48 | H | 0 | CH=CH-CH=CH | H |  |
| 49 | H | 0 | CH=CH-CH=CH | H |  |
| 50 | H | 0 | C≡C | H |  |

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Table 1 (continued)

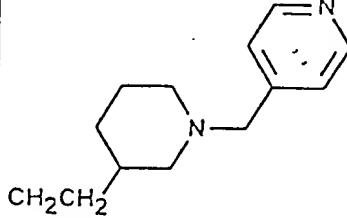
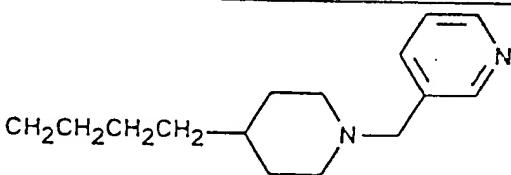
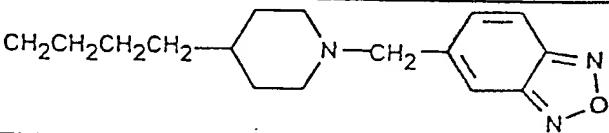
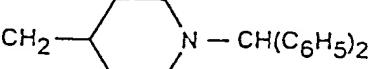
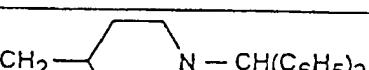
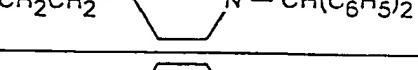
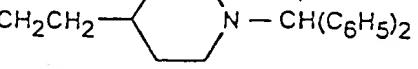
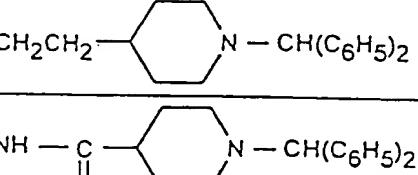
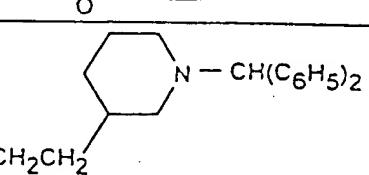
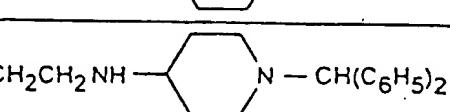
| Nr | R' | k | A | R" | D-E-G |
|----|----|---|-------------|----|--------------------------------------------------------------------------------------|
| 51 | H | 0 | CH=CH | H |  |
| 52 | H | 0 | CH=CH-CH=CH | H |  |
| 53 | H | 0 | CH=CH | H |  |
| 54 | H | 0 | CH=CH | H |  |
| 55 | H | 0 | CH=CH-CH=CH | H |  |
| 56 | H | 1 | CH=CH | H |  |
| 57 | H | 0 | CH=CH(CH2)2 | H |  |
| 58 | H | 0 | CH=CHCH2CHF | H |  |
| 59 | H | 0 | CH=CH | H |  |
| 60 | H | 0 | CH=CH | H |  |
| 61 | H | 0 | CH=CH-CH=CH | H |  |
| 62 | H | 0 | CH=CH | H |  |

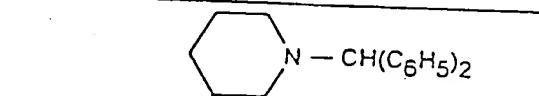
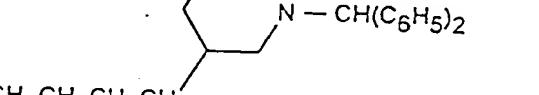
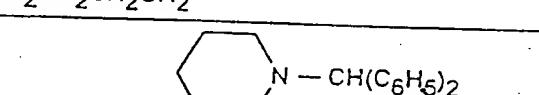
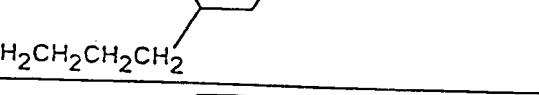
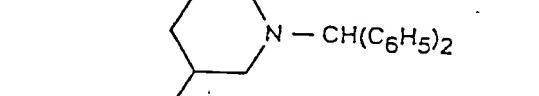
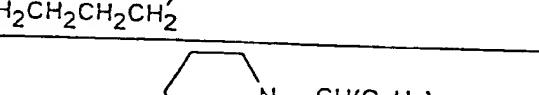
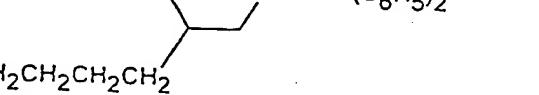
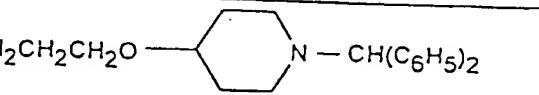
Table 1 (continued)

- 58 -

| Nr | R ¹ | k | A | R ⁴ | D-E-G |
|----|----------------|---|---------------------------------------|-----------------|----------------------------------------|
| 63 | H | 1 | CH=CH | H | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 64 | H | 0 | CH=CH | OH | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 65 | H | 0 | CH=C CN | H | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 66 | H | 0 | C≡C | H | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 67 | H | 0 | CH=CH(CH ₂) ₂ | H | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 68 | H | 0 | CH=CHCHCF ₂ OH | H | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 69 | H | 0 | (CH ₂) ₂ CH=CH | H | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 70 | H | 0 | CH=CH-CH=CH | H | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 71 | H | 0 | CH=CH-CH=CH | CH ₃ | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 72 | 2-F | 0 | CH=CH-CH=CH | H | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 73 | 2-F | 0 | CH=CH-CH=CH | OH | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 74 | 4-F | 0 | CH=CH-CH=CH | H | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 75 | 5-F | 0 | CH=CH-CH=CH | H | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 76 | 6-F | 0 | CH=CH-CH=CH | H | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |
| 77 | 2-Cl | 0 | CH=CH-CH=CH | H | <chem>CH2CH2CH2CH2-C1CCCCN(C)C1</chem> |

Table 1 (continued)

- 59 -

| Nr | R ¹ | k | A | R ⁴ | D-E-G |
|----|---------------------|---|----------------------|----------------|--------------------------------------------------------------------------------------|
| 78 | 6-CH ₃ | 0 | CH=CH-CH=CH | H |  |
| 79 | 2-OH | 0 | CH=CH-CH=CH | H |  |
| 80 | H | 0 | (CH=CH) ₃ | H |  |
| 81 | H | 0 | CH=CH | H |  |
| 82 | 2-F | 0 | CH=CH | H |  |
| 83 | 5-F | 0 | CH=CH | H |  |
| 84 | 6-CH ₃ O | 0 | CH=CH | H |  |
| 85 | H | 0 | CH=CH-CH=CH | H |  |
| 86 | H | 0 | CH=CH | H |  |
| 87 | H | 0 | CH=CH-CH=CH | H |  |
| 88 | H | 0 | CH=CH | H |  |
| 89 | H | 0 | CH=CH | H |  |

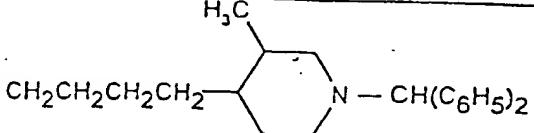
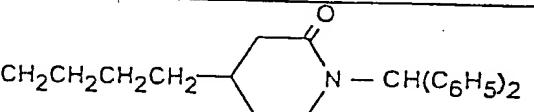
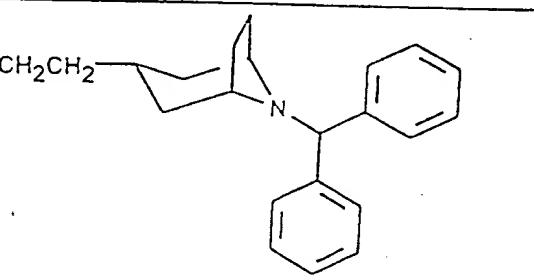
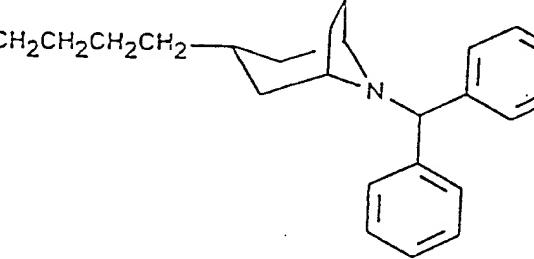
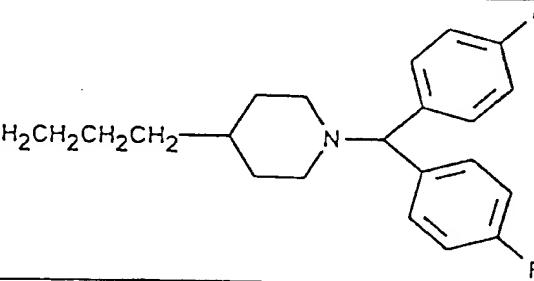
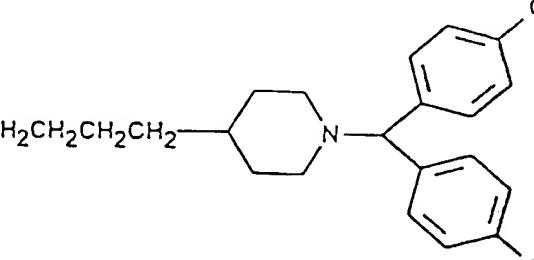
- 60 -

Table 1 (continued)

| Nr | R' | K | A | R ⁴ | D-E-G |
|-----|----|---|-------------|----------------|-----------------------------------------------------|
| 90 | H | O | CH=CH | H | <chem>CH2CH=CHCH2-c1ccccc1N-C(C6H5)2</chem> |
| 91 | H | O | CH=CH | H | <chem>CH2C#CCH2-c1ccccc1N-C(C6H5)2</chem> |
| 92 | H | O | CH=CH | H | <chem>CH2CH2CH2CH2-c1ccccc1N-C(C6H5)2</chem> |
| 93 | H | O | CH=CH-CH=CH | H | <chem>CH2CH2CH2CH2CH2-c1ccccc1N-C(C6H5)2</chem> |
| 94 | H | O | CH=CH | H | <chem>CH2CH2CH2OCH2-c1ccccc1N-C(C6H5)2</chem> |
| 95 | H | O | CH=CH-CH=CH | H | <chem>CH2CH2CH2OCH2-c1ccccc1N-C(C6H5)2</chem> |
| 96 | H | O | CH=CH | H | <chem>OCH2CH2CH2CH2-c1ccccc1N-C(C6H5)2</chem> |
| 97 | H | O | CH=CH | H | <chem>CH2CH2NH-C(=O)O-c1ccccc1N-C(C6H5)2</chem> |
| 98 | H | O | CH=CH-CH=CH | H | <chem>CH2CH2CH2CH2CH2CH2-c1ccccc1N-C(C6H5)2</chem> |
| 99 | H | O | CH=CH | H | <chem>CH2CH2CH2OCH2CH2-c1ccccc1N-C(C6H5)2</chem> |
| 100 | H | O | CH=CH | H | <chem>CH2CH2CH2CH2NH-C(=O)c1ccccc1N-C(C6H5)2</chem> |
| 101 | H | O | CH=CH | H | <chem>(CH2)7-c1ccccc1N-C(C6H5)2</chem> |
| 102 | H | O | CH=CH | H | <chem>(CH2)8-c1ccccc1N-C(C6H5)2</chem> |
| 103 | H | O | CH=CH | H | <chem>(CH2)6NH-C(=O)c1ccccc1N-C(C6H5)2</chem> |

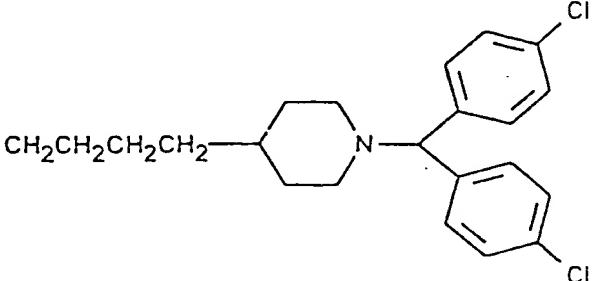
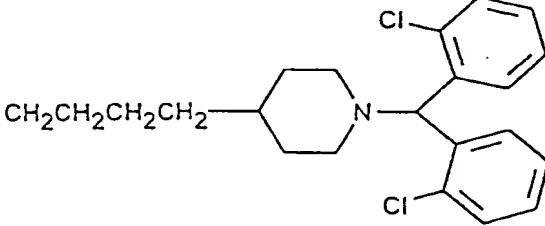
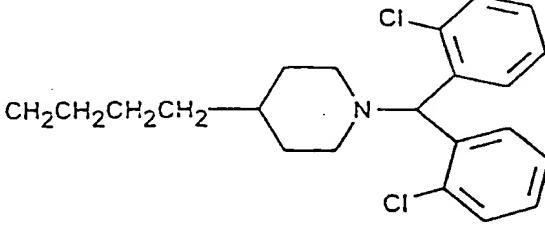
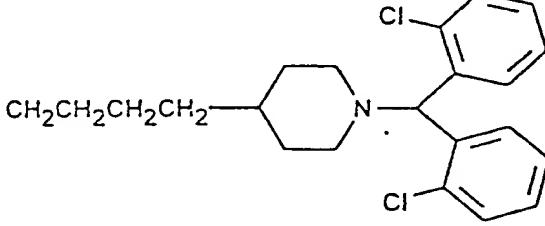
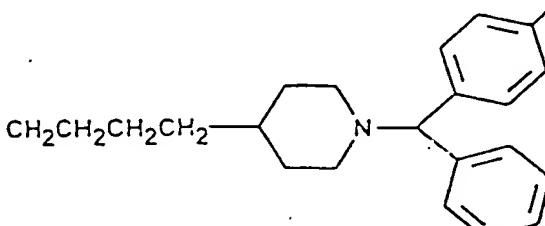
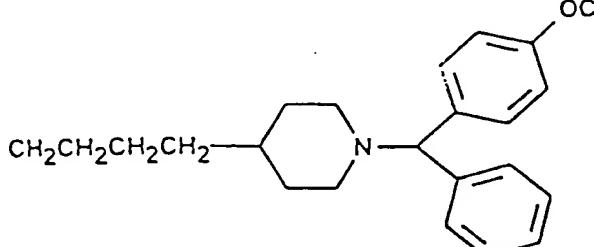
- 61 -

Table 1 (continued)

| Nr | R' | k | A | R* | D-E-G |
|-----|----|---|-------------|----|--------------------------------------------------------------------------------------|
| 104 | H | O | CH=CH | H |  |
| 105 | H | O | CH=CH | H |  |
| 106 | H | O | CH=CH | H |  |
| 107 | H | O | CH=CH | H |  |
| 108 | H | O | CH=CH | H |  |
| 109 | H | O | CH=CH-CH=CH | H |  |
| 110 | H | O | C≡C | H |  |

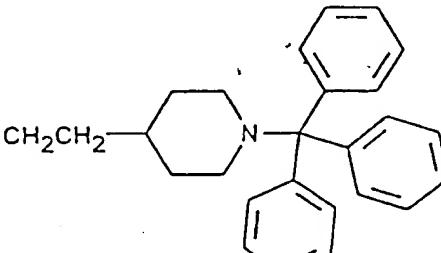
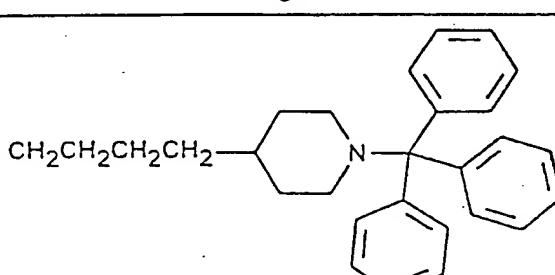
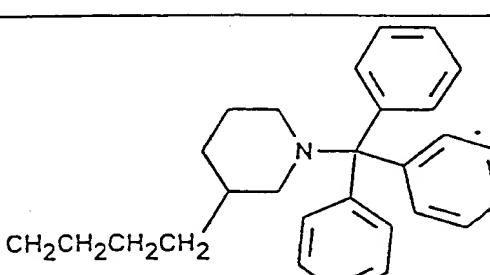
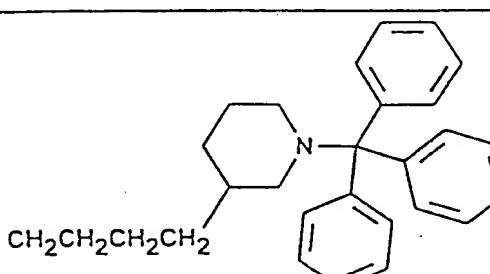
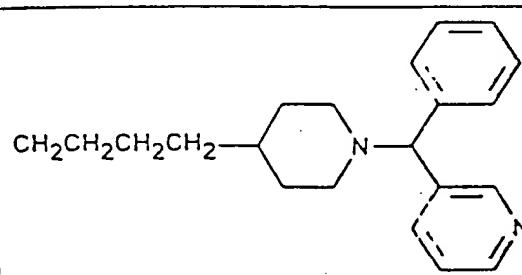
- 62 -

Table 1 (continued)

| Nr | R ¹ | K | A | R ⁴ | D-E-G |
|-----|----------------|---|---------------------------------------|----------------|--------------------------------------------------------------------------------------|
| 111 | H | 0 | CH=CH-CH=CH | H |  |
| 112 | H | 0 | C≡C | H |  |
| 113 | H | 0 | (CH ₂) ₂ CH=CH | H |  |
| 114 | H | 0 | CH=CH-CH=CH | H |  |
| 115 | H | 0 | CH=CH-CH=CH | H |  |
| 116 | H | 0 | CH=CH-CH=CH | H |  |

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Table 1 (continued)

| Nr | R' | k | A | R' | D-E-G |
|-----|----|---|-------------|----|--------------------------------------------------------------------------------------|
| 117 | H | 0 | CH=CH-CH=CH | H |  |
| 118 | H | 0 | CH=CH-CH=CH | H |  |
| 119 | H | 0 | CH=CH | H |  |
| 120 | H | 0 | CH=CH-CH=CH | H |  |
| 121 | H | 0 | CH=CH | H |  |

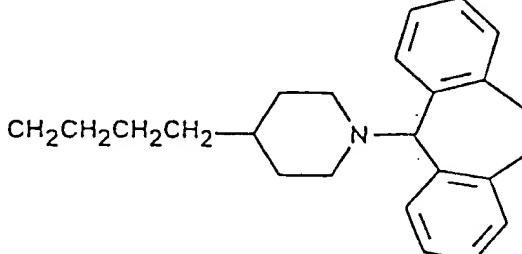
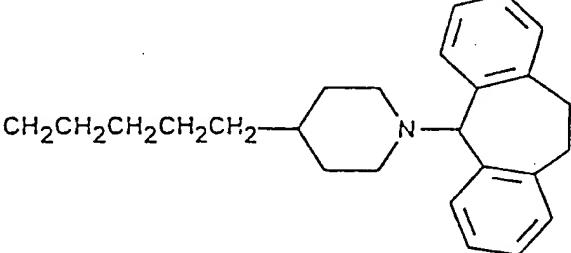
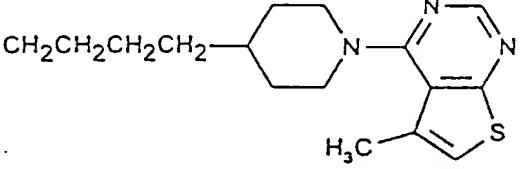
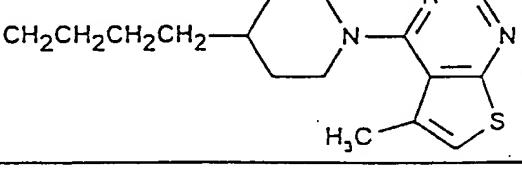
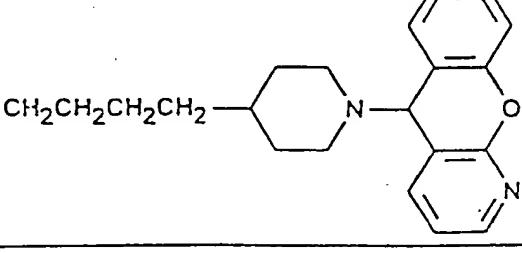
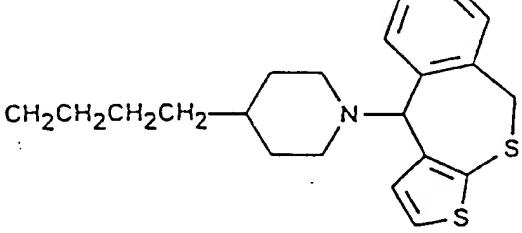
- 64 -

Table 1 (continued)

| Nr | R ¹ | k | A | R ⁴ | D-E-G |
|-----|----------------|---|-----------------------------------------|----------------|-------|
| 122 | H | 0 | CH=CH-CH=CH | H | |
| 123 | H | 0 | CH=CH | H | |
| 124 | H | 0 | CH=CH-CH=CH | H | |
| 125 | H | 0 | CH=C CN | H | |
| 126 | H | 0 | CH=CH-CH=CH | H | |
| 127 | H | 0 | CH=CH-CH ₂ C(F) ₂ | H | |

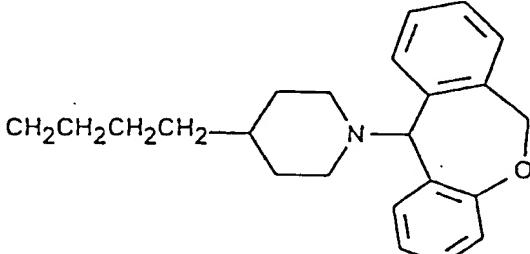
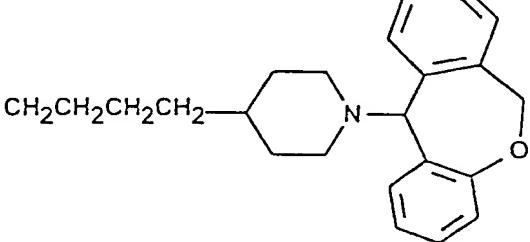
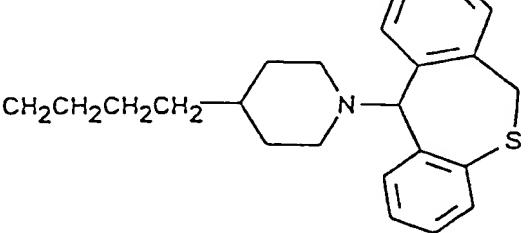
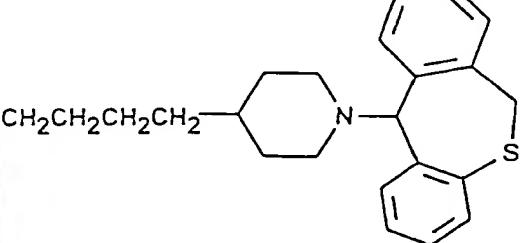
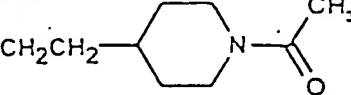
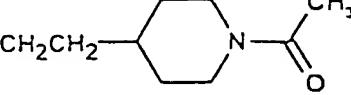
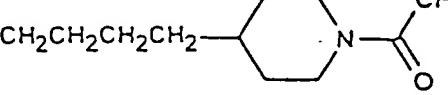
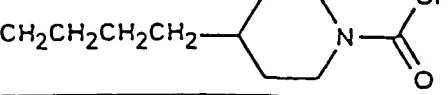
- 65 -

Table 1 (continued)

| Nr | R ¹ | K | A | R ⁴ | D-E-G |
|-----|----------------|---|-------------|----------------|--------------------------------------------------------------------------------------|
| 128 | H | O | CH=CH-CH=CH | H |  |
| 129 | H | O | C≡C | H |  |
| 130 | H | O | CH=CH | H |  |
| 131 | H | O | CH=CH-CH=CH | H |  |
| 132 | H | O | CH=CH | H |  |
| 133 | H | O | CH=CH | H |  |

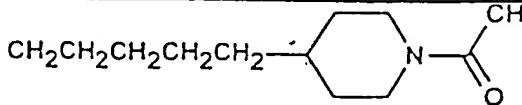
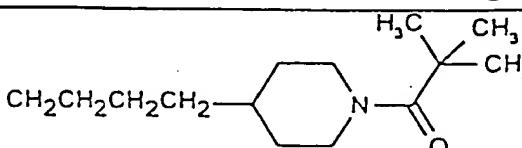
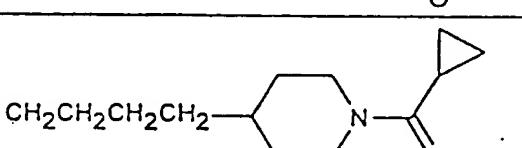
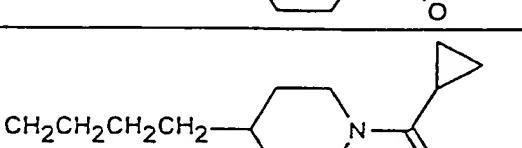
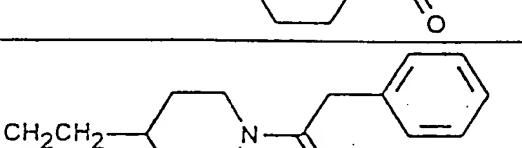
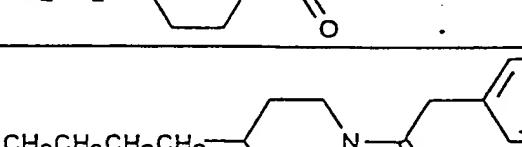
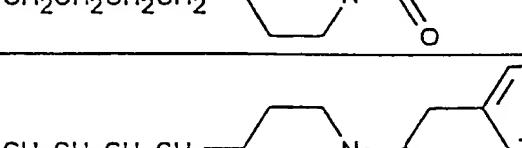
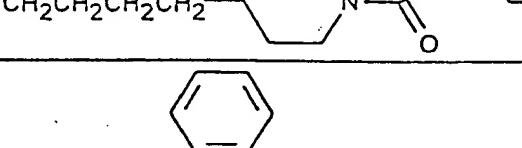
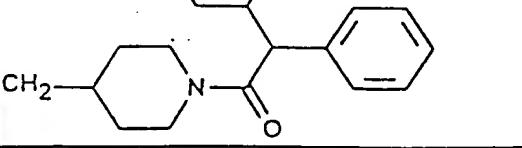
- 66 -

Table 1 (continued)

| Nr | R ¹ | K | A | R ⁴ | D-E-G |
|-----|----------------|---|-------------|----------------|--------------------------------------------------------------------------------------|
| 134 | H | O | CH=CH | H |  |
| 135 | H | O | CH=CH-CH=CH | H |  |
| 136 | H | O | CH=CH | H |  |
| 137 | H | O | CH=CH-CH=CH | H |  |
| 138 | H | O | CH=CH | H |  |
| 139 | H | O | CH=CH-CH=CH | H |  |
| 140 | H | O | CH=CH | H |  |
| 141 | H | O | CH=CH-CH=CH | H |  |

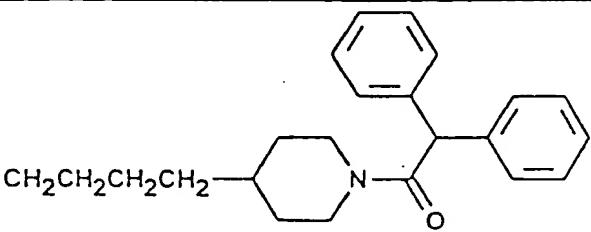
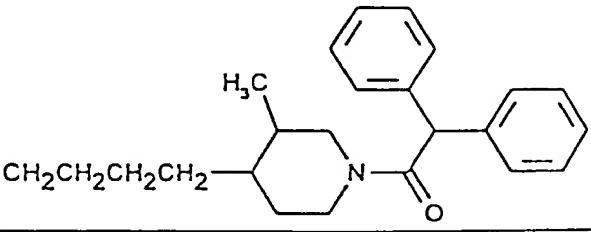
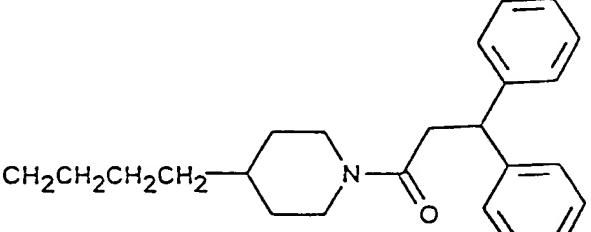
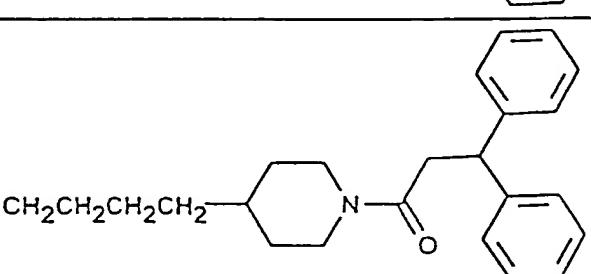
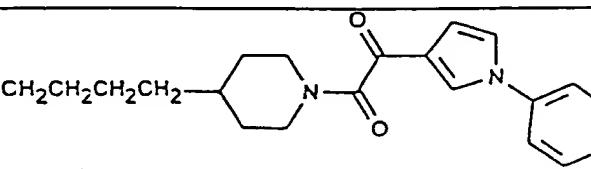
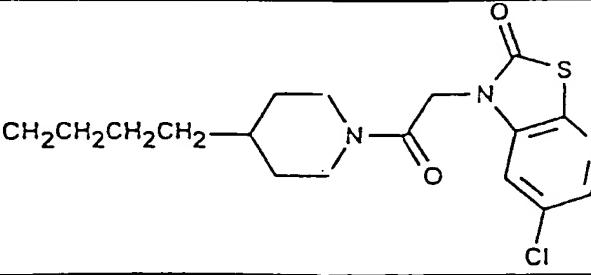
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Table 1 (continued)

| Nr | R' | k | A | R ⁴ | D-E-G |
|-----|----|---|--------------------------------------|----------------|--------------------------------------------------------------------------------------|
| 142 | H | 0 | CH=CH | H |  |
| 143 | H | 0 | CH=CH | H |  |
| 144 | H | 0 | CH=CH | H |  |
| 145 | H | 0 | CH=CH-CH=CH | H |  |
| 146 | H | 0 | CH=CH | H |  |
| 147 | H | 0 | CH=CH | H |  |
| 148 | H | 0 | CH=CH-CH=CH | H |  |
| 149 | H | 0 | CH=CH(CH ₂) ₂ | H |  |
| 150 | H | 0 | CH=CH | H |  |

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Table 1 (continued)

| Nr | R ¹ | k | A | R ⁴ | D-E-G |
|-----|----------------|---|-------------|----------------|--------------------------------------------------------------------------------------|
| 151 | H | O | CH=CH-CH=CH | H |  |
| 152 | H | O | CH=CH | H |  |
| 153 | H | O | CH=CH | H |  |
| 154 | H | O | CH=CH-CH=CH | H |  |
| 155 | H | O | CH=CH | H |  |
| 156 | H | O | CH=CH | H |  |

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Table 1 (continued)

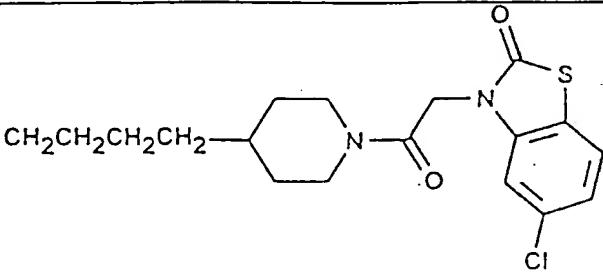
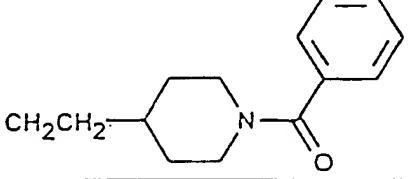
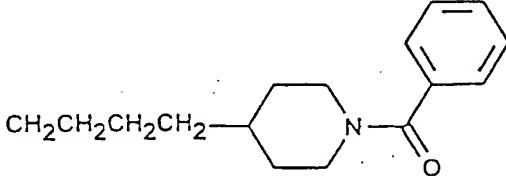
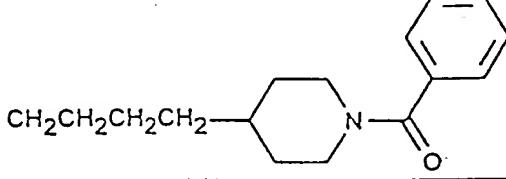
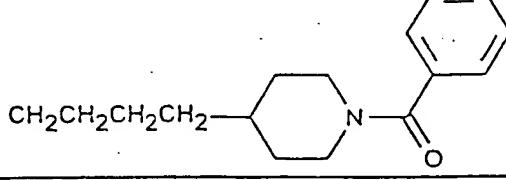
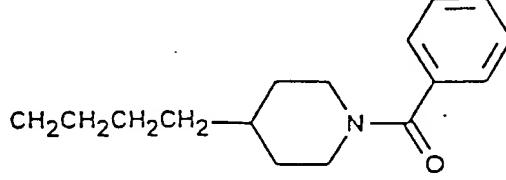
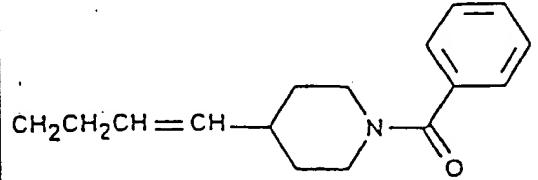
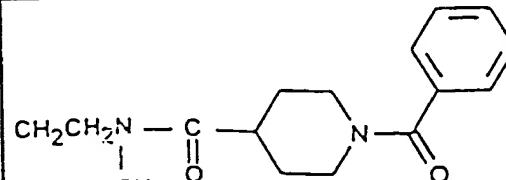
| Nr | R ¹ | K | A | R ⁴ | D-E-G |
|-----|----------------|---|------------------------------|-----------------|--------------------------------------------------------------------------------------|
| 157 | H | O | CH=CH-CH=CH | H |  |
| 158 | H | O | CH=CH | H |  |
| 159 | H | O | CH=CH | H |  |
| 160 | H | O | CH=C CH ₃ | H |  |
| 161 | H | O | CH=CHCHCHF OH | H |  |
| 162 | H | O | CH=CH-CH=CH | H |  |
| 163 | H | O | CH=CH | H |  |
| 164 | H | O | CH=CH | CH ₃ |  |

Table 1 (continued)

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| Nr | R' | k | A | R ⁴ | D-E-G |
|-----|-----|---|---------------------------------------|----------------|-------|
| 165 | H | O | CH=CH | H | |
| 166 | H | O | CH=CH | H | |
| 167 | H | O | CH=CH | H | |
| 168 | H | O | CH=CH-CH=CH | H | |
| 169 | H | O | CH=CH | H | |
| 170 | H | O | (CH ₂) ₂ CH=CH | H | |
| 171 | H | O | CH=CH | H | |
| 172 | 2-F | O | CH=CH | H | |
| 173 | H | O | CH=CH-CH=CH | H | |

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Table 1 (continued)

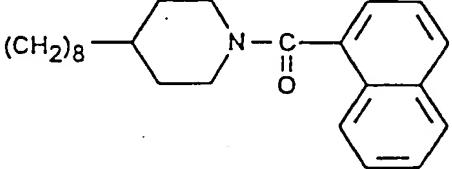
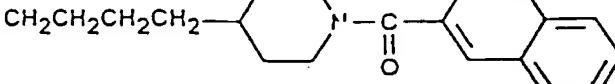
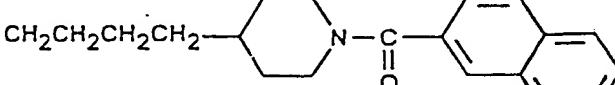
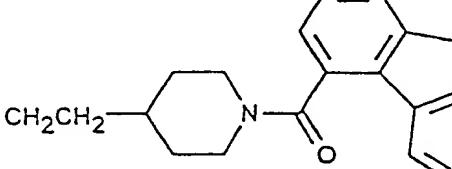
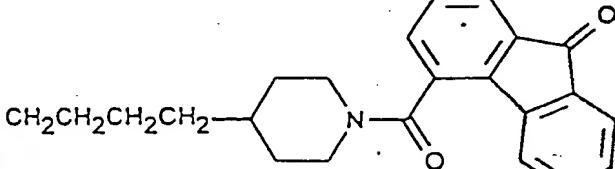
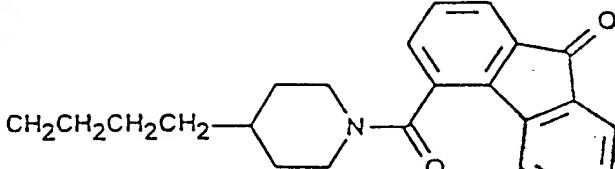
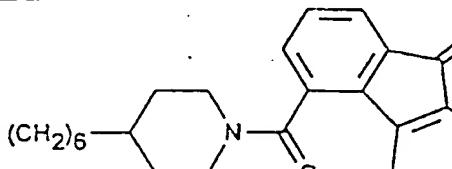
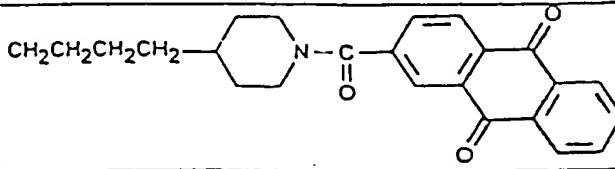
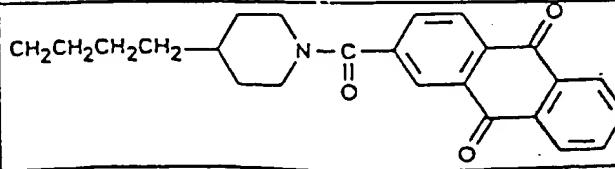
| Nr | R' | k | A | R ⁴ | D-E-G |
|-----|-----|---|-------------|----------------|--------------------------------------------------------------------------------------|
| 174 | H | 0 | CH=CH | H |  |
| 175 | H | 0 | CH=CH | H |  |
| 176 | H | 0 | CH=CH-CH=CH | H |  |
| 177 | H | 0 | CH=CH | H |  |
| 178 | H | 0 | CH=CH | H |  |
| 179 | H | 0 | CH=CH-CH=CH | H |  |
| 180 | H | 0 | CH=CH | H |  |
| 181 | H | 0 | CH=CH | H |  |
| 182 | 4-F | 0 | CH=CH | H |  |

Table 1 (continued)

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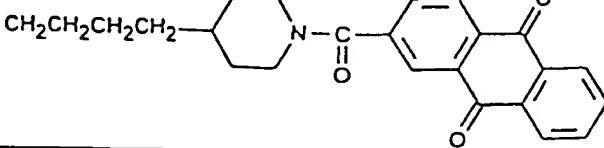
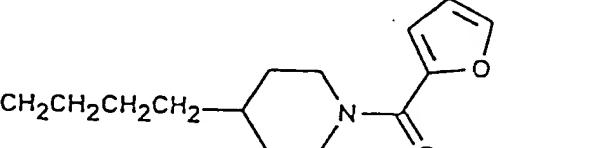
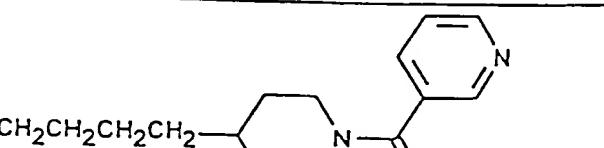
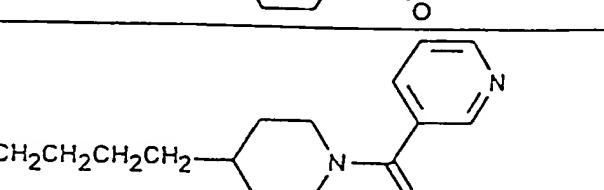
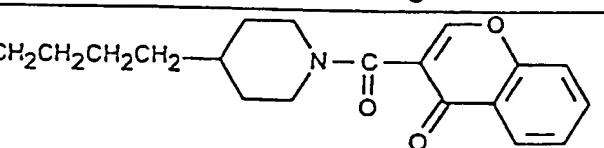
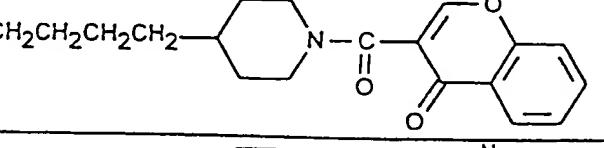
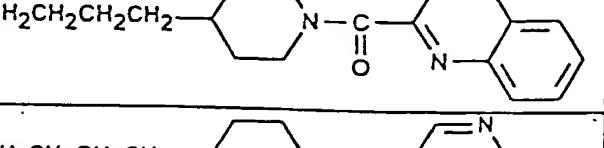
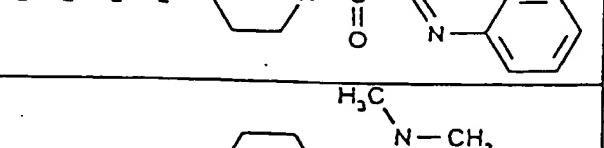
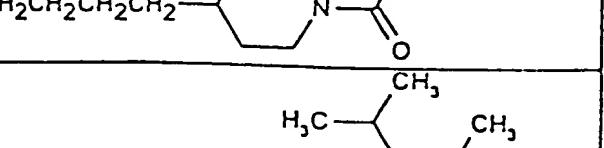
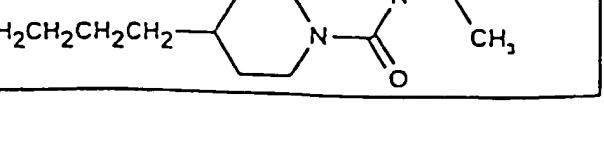
| Nr | R' | k | A | R ⁴ | D-E-G |
|-----|----|---|----------------------|----------------|--------------------------------------------------------------------------------------|
| 183 | H | O | CH=CH-CH=CH | H |  |
| 184 | H | O | CH=CH | H |  |
| 185 | H | O | CH=CH | H |  |
| 186 | H | O | (CH=CH) ₃ | H |  |
| 187 | H | O | CH=CH | H |  |
| 188 | H | O | CH=CH-CH=CH | H |  |
| 189 | H | O | CH=CH | H |  |
| 190 | H | O | C≡C | H |  |
| 191 | H | O | CH=CH | H |  |
| 192 | H | O | CH=CH | H |  |

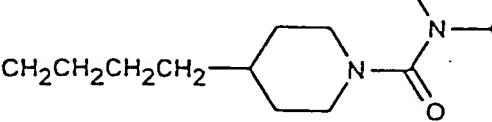
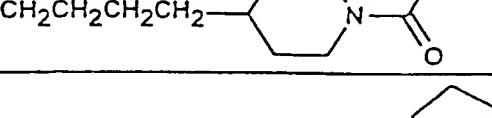
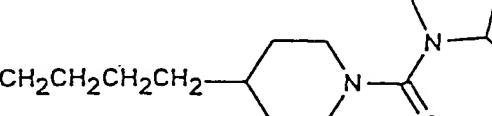
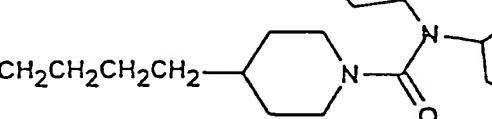
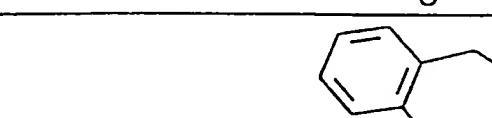
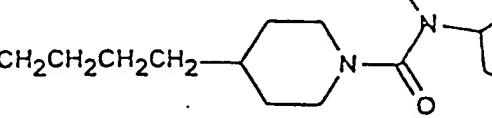
Table 1 (continued)

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| Nr | R' | k | A | R ⁴ | D-E-G |
|-----|------|---|-------------|----------------|-------|
| 193 | H | O | CH=CH | H | |
| 194 | H | O | CH=CH-CH=CH | H | |
| 195 | H | O | CH=CH | H | |
| 196 | 2-Cl | O | CH=CH | H | |
| 197 | H | O | CH=CH | H | |
| 198 | H | O | CH=CH | H | |
| 199 | H | O | CH=CH | H | |

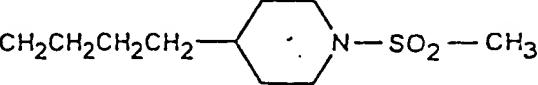
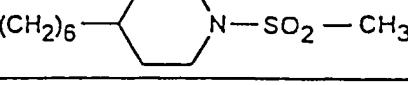
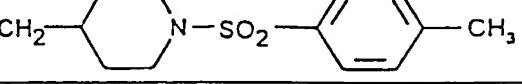
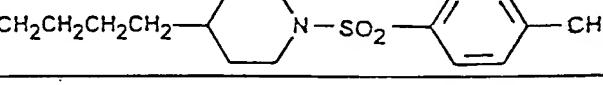
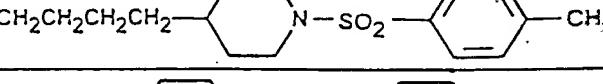
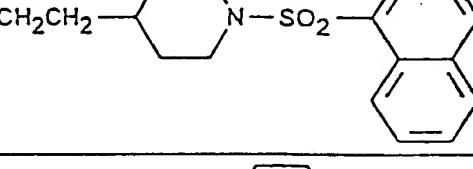
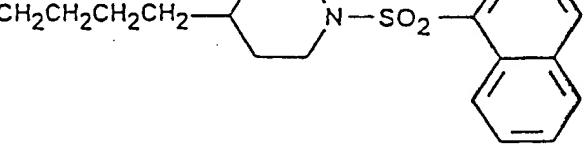
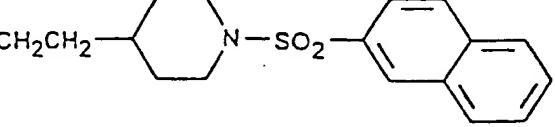
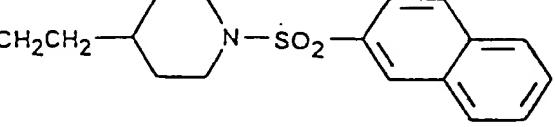
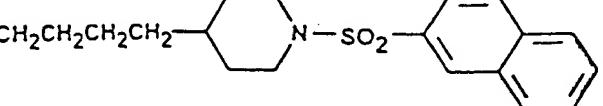
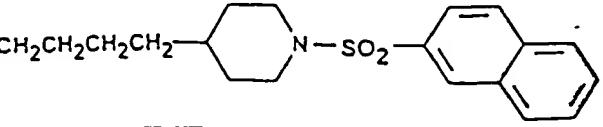
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Table 1 (continued)

| Nr | R ¹ | k | A | R ⁴ | D-E-G |
|-----|----------------|---|-------------|----------------|--------------------------------------------------------------------------------------|
| 200 | H | O | CH=CH-CH=CH | H |  |
| 201 | H | O | CH=CH | H |  |
| 202 | H | O | CH=CH-CH=CH | H |  |
| 203 | H | O | CH=CH | H |  |
| 204 | H | O | CH=CH-CH=CH | H |  |
| 205 | H | O | CH=CH | H |  |
| 206 | H | O | CH=CH-CH=CH | H |  |
| 207 | H | O | CH=CH | H |  |

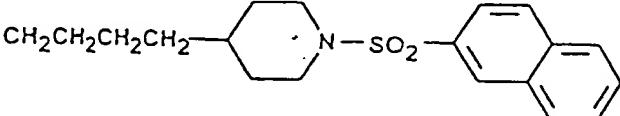
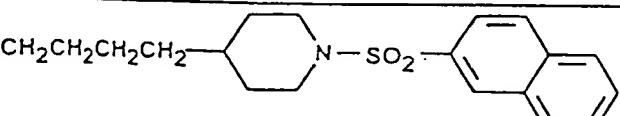
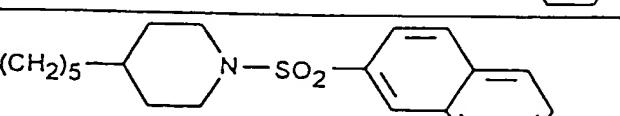
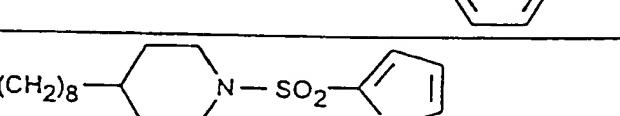
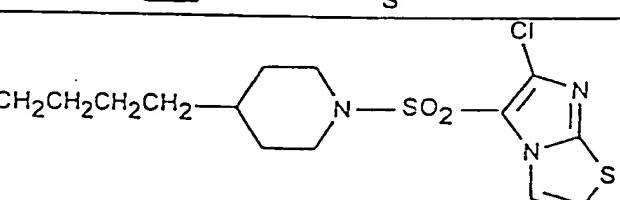
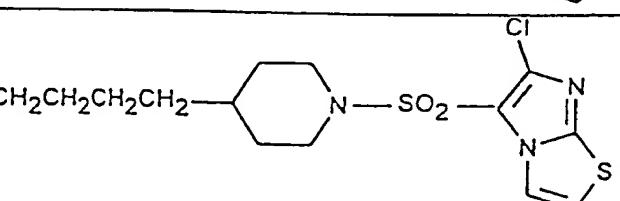
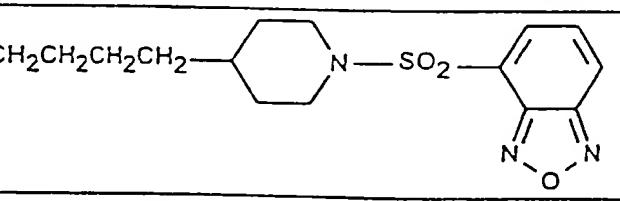
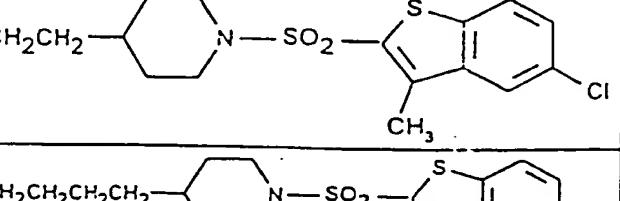
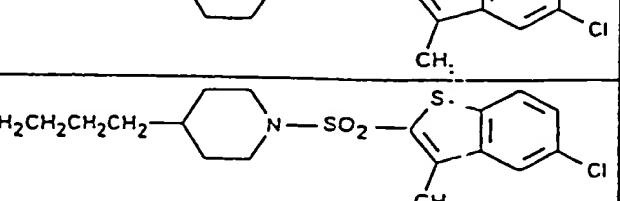
- 75 -

Table 1 (continued)

| Nr | R' | k | A | R ⁴ | D-E-G |
|-----|----|---|-------------|----------------|--------------------------------------------------------------------------------------|
| 208 | H | 0 | CH=CH | H |  |
| 209 | H | 0 | CH=CH-CH=CH | H |  |
| 210 | H | 0 | CH=CH | H |  |
| 211 | H | 0 | CH=CH | H |  |
| 212 | H | 0 | CH=CH | H |  |
| 213 | H | 0 | CH=CH | H |  |
| 214 | H | 0 | CH=CH-CH=CH | H |  |
| 215 | H | 0 | CH=CH | H |  |
| 216 | H | 0 | CH=CH | H |  |
| 217 | H | 0 | CH=CH | H |  |
| 218 | H | 0 | CH=CH-CH=CH | H |  |
| 219 | H | 0 | CH=CH | H |  |
| 220 | H | 0 | C≡C | H |  |

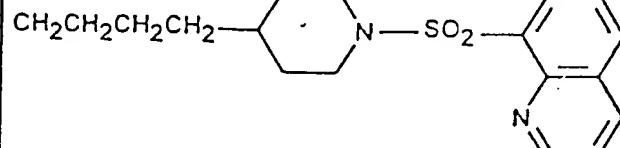
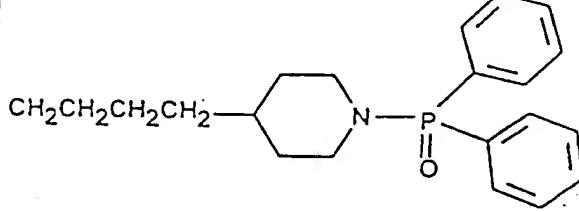
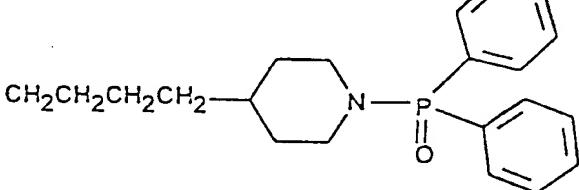
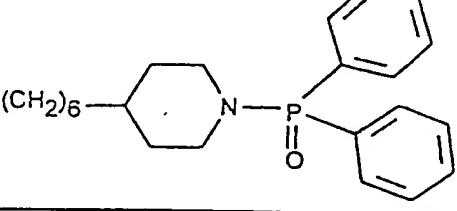
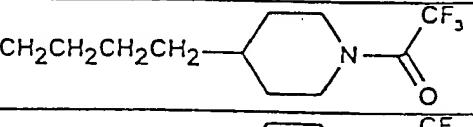
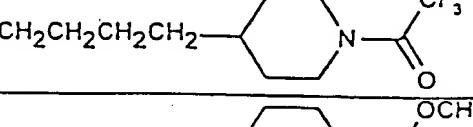
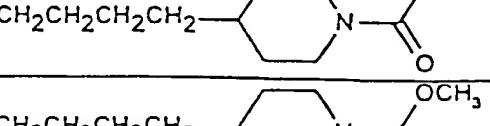
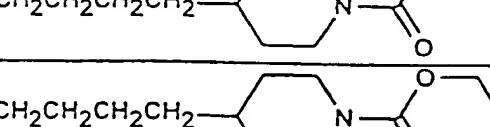
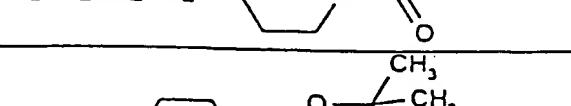
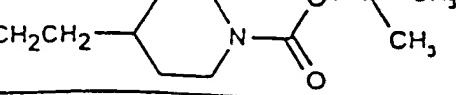
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Table 1 (continued)

| Nr | R ¹ | k | A | R ⁴ | D-E-G |
|-----|----------------|---|---------------------------------------|----------------|--------------------------------------------------------------------------------------|
| 221 | H | 0 | (CH ₂) ₂ CH=CH | H |  |
| 222 | H | 0 | CH=CH-CH=CH | H |  |
| 223 | H | 0 | CH=CH | H |  |
| 224 | H | 0 | CH=CH | H |  |
| 225 | H | 0 | CH=CH | H |  |
| 226 | H | 0 | CH=CH-CH=CH | H |  |
| 227 | H | 0 | CH=CH | H |  |
| 228 | H | 0 | CH=CH | H |  |
| 229 | H | 0 | CH=CH | H |  |
| 230 | H | 0 | CH=CH-CH=CH | H |  |

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Table 1 (continued)

| Nr | R' | k | A | R* | D-E-G |
|-----|----|---|-------------|----|--------------------------------------------------------------------------------------|
| 231 | H | O | CH=CH | H |  |
| 232 | H | O | CH=CH | H |  |
| 233 | H | O | CH=CH-CH=CH | H |  |
| 234 | H | O | CH=CH | H |  |
| 235 | H | O | CH=CH | H |  |
| 236 | H | O | CH=CH-CH=CH | H |  |
| 237 | H | O | CH=CH | H |  |
| 238 | H | O | CH=CH-CH=CH | H |  |
| 239 | H | O | CH=CH | H |  |
| 240 | H | O | CH=CH | H |  |

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Table 1 (continued)

| Nr | R' | k | A | R* | D-E-G |
|-----|----|---|----------------------|----|-------|
| 241 | H | O | CH=CH-CH=CH | H | |
| 242 | H | O | CH=CH | H | |
| 243 | H | O | CH=CH-CH=CH | H | |
| 244 | H | O | C≡C | H | |
| 245 | H | O | (CH=CH) ₃ | H | |
| 246 | H | O | CH=CH | H | |
| 247 | H | O | CH=CH | H | |
| 248 | H | O | CH=CH | H | |
| 249 | H | O | CH=CH | H | |
| 250 | H | O | CH=CH | H | |

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Table 1 (continued)

| Nr | R' | k | A | R ⁴ | D-E-G |
|-----|----|---|-------------|----------------|-------|
| 251 | H | O | CH=CH-CH=CH | H | |
| 252 | H | O | CH=CH | H | |
| 253 | H | O | CH=CH | H | |
| 254 | H | O | CH=CH | H | |
| 255 | H | O | CH=CH-CH=CH | H | |
| 256 | H | O | CH=CH | H | |
| 257 | H | O | CH=CH-CH=CH | H | |

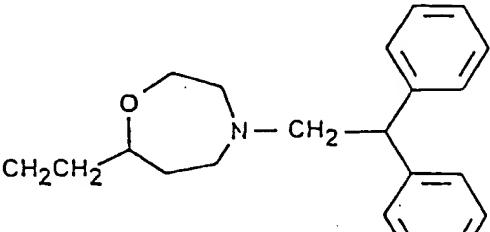
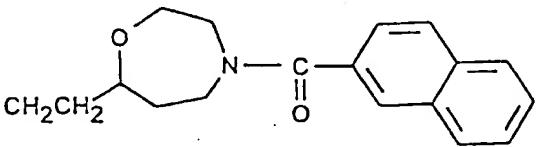
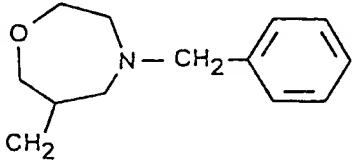
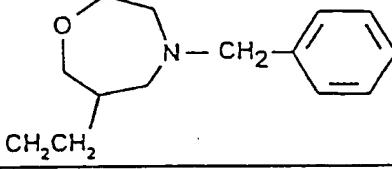
- 80 -

Table 1 (continued)

| Nr | R' | k | A | R' | D-E-G |
|-----|----|---|-------------|----|-------|
| 258 | H | O | CH=CH | H | |
| 259 | H | O | CH=CH | H | |
| 260 | H | O | CH=CH | H | |
| 261 | H | O | CH=CH-CH=CH | H | |
| 262 | H | O | C≡C | H | |
| 263 | H | O | CH=CH | H | |
| 264 | H | O | CH=CH | H | |

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Table 1 (continued)

| Nr | R ¹ | K | A | R ⁴ | D-E-G |
|-----|----------------|---|-------------|----------------|-------------------------------------------------------------------------------------|
| 265 | H | O | CH=CH | H |  |
| 266 | H | O | CH=CH | H |  |
| 267 | H | O | CH=CH | H |  |
| 268 | H | O | CH=CH-CH=CH | H |  |

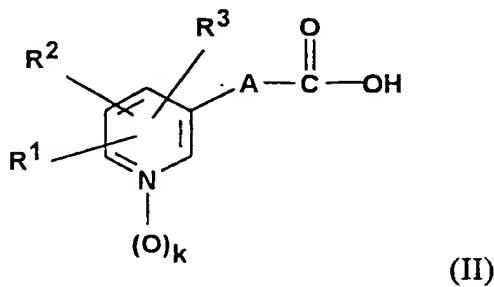
SYNTHESIS METHODS

Further subject-matter of the invention are analogous methods for the production of the compounds of formula (I) according to the invention.

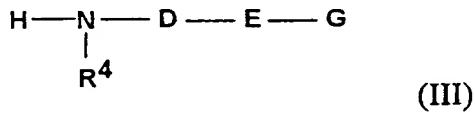
Method (A):

Compounds of formula (I) are

(a) obtained by reacting carboxylic acids of formula (II)



in which R¹, R², R³, A and k have the meaning described above or their reactive derivatives are reacted with compounds of formula (III)



wherein D, E, G and R⁴ also have the above described meanings.

Reactive derivatives of compound (II) can be, for example, activated esters, anhydrides, acid halides (especially acid chlorides) or simple low alkyl esters. Suitable activated esters are, for example, p-nitrophenyl ester, 2,4,6-trichlorophenyl ester, pentachlorophenyl ester, cyanomethyl ester, esters of N-hydroxysuccinimide, of N-hydroxyphthalimides, of 1-hydroxybenzotriazol, of N-hydroxypiperidine, of 2-

hydroxypyridine or of 2-mercaptopypyridine, etc. Anhydrides can be symmetric anhydrides or mixed, as they are obtained, for example, with pivaloyl chloride or with chloroformates. Aromatic (for example chloroformic phenyl ester), araliphatic (for example chloroformic benzyl ester) or aliphatic chloroformates (for example chloroformic methyl ester, -ethyl ester or -isobutyl ester) can be used for this.

Reaction of compounds (II) with compounds (III) can also be carried out in the presence of condensation agents such as dicyclohexylcarbodiimide, 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide hydrochloride, N,N'-carbonyldiimidazol, 1-ethoxycarbonyl-2-ethoxy-1,2-dihydroquinoline, etc. If carbodiimides are used as the condensation agent, reagents such as N-hydroxysuccinimide, N-hydroxyphthalimide, 1-hydroxybenzotriazol, N-hydroxypiperidine, etc. can be advantageously added.

Compounds of formula (III) can be used for reaction as free bases as well as in the form of their acid addition salts. For this, the salts of inorganic acids are to be preferred, i.e. hydrochlorides, hydrobromides or sulfates.

Reaction of compounds (II) or their reactive derivatives with compounds (III) are normally carried out in a suitable, preferably inert solvent. As examples, aromatic hydrocarbons such as benzene, toluene, xylene, halogenated hydrocarbons (for example dichloromethane, chloroform, 1,2-dichloroethane, trichloroethylene), ether (for example diethyl ether, tetrahydrofuran, dioxane, glycol dimethyl ether), ethyl acetate, acetonitrile or polar aprotic solvents such as, for example, dimethylsulfoxide, dimethylformamide or N-methylpyrrolidone are to be named. Pure solvents, as well as mixtures of two or more, can be used.

The reaction is optionally carried out in the presence of an auxiliary base. Suitable examples for this are alkali metal carbonates (sodium carbonate, potassium carbonate), alkali metal hydrogen carbonates (sodium hydrogen carbonate, potassium hydrogen carbonate), or organic bases such as, for example, triethylamine, ethyl diisopropylamine, tributylamine, N-methylmorpholine or pyridine. A suitable excess of

compound (III) can also be used as a base. If compounds (III) are used in form of their acid addition salts, then it is appropriate to consider the amount of auxiliary base used as equivalent.

The reaction temperatures can - depending on reactivity of the educts - vary in a wide range. Generally, the reaction is carried out at temperatures between -40°C and 180°C, preferably between -10°C and 130°C, especially at the boiling point of the solvent used.

The starting compounds (II) and (III) are known and/or can be produced according to known methods in an analogous manner. Moreover, the production of representative examples is further described below.

Compounds of formula (I) can be

(b) produced by reaction of compounds of formula (I), wherein G is hydrogen, and which themselves also have the activities found according to the invention, with a compound of formula (IV),



in which G has the meaning given above, with the exception of hydrogen, and L represents a suitable nucleofuge or reactive group. The type of nucleofuge or reactive group L and the conditions of the reaction are dependent of the nature of group G.

Compounds of formula (I), in which G, with the exception of hydrogen, has the meaning of (G1) according to the above definition can, aside from method (a), also be

(c) produced by reacting compounds of formula (I), in which G is hydrogen, with a suitable alkylation agent and/or arylation agent of formula (IV), wherein G is an alkyl-,

alkenyl-, alkinyl-, cycloalkyl-, aryl-, aralkyl-, heteroaryl- or heteroaralkyl residue and the leaving group L can represent a reactive derivative of an alkohol, for example, a halogen atom such as chlorine, bromine or iodine or a sulfonic acid ester, i.e. for example a methanesulfonyloxy-, trifluoromethanesulfonyloxy-, ethanesulfonyloxy-, benzenesulfonyloxy-, p-toluenesulfonyloxy-, p-bromobenzenesulfonyloxy- or m-nitrobenzenesulfonyloxy residue, etc. or a reactive group L can also be an epoxide group, wherein the reaction occurs under addition.

The reaction of compounds (I), in which G is a hydrogen, and (IV) is usually conducted in a suitably inert solvent. As solvents of this type, aromatic hydrocarbons (benzene, toluene, xylene), ethers (for example tetrahydrofuran, dioxane, glycol dimethyl ether), ethyl acetate, acetonitrile, ketones (acetone, ethyl methyl ketone), polar protic solvents such as alcohols (ethanol, isopropanol, butanol, glycol monomethyl ether) or polar aprotic solvents such as, for example, dimethylsulfoxide, dimethylformamide or N-methylpyrrolidone can be considered. Pure solvents as well as mixtures of two or more can also be used. Preferably, the reactions are carried out in the presence of bases, whereby said bases can be used as in method (a) above. If chlorides or bromides are used as compound (IV), the reaction can be accelerated by the addition of alkali metal iodides (sodium iodide, potassium iodide). The reaction temperatures can vary between 0°C and 180°C depending on the reactivity of the educts, but preferably lie between 20°C and 130°C.

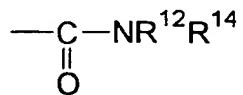
Compounds of formula (I), in which G represents an acyl residue, a carbamoyl residue, a sulfonyl residue or a phosphinoyl residue according to the above definition, can also be produced, aside from the above method (a),

(d) by reacting compounds of formula (I), wherein G is hydrogen, with a carboxylic acid, carbamic acid, sulfonic acid and/or phosphinic acid of formula (V),



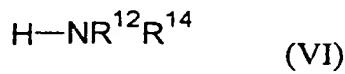
wherein **G** is an acyl residue, carbamoyl residue, sulfonyl residue or phosphinoyl residue according to definition, or their derivatives capable of reaction. Preferred derivatives of carboxylic acids and/or sulfonic acids (V) which are capable of reaction are symmetric or unsymmetric carboxylic acid anhydrides and/or sulfonic acid anhydrides or acyl- and/or sulfonyl halides, especially acyl- and/or sulfonyl chlorides. Preferably, derivatives of carbamates and/or phosphinic acids which are capable of reaction are the carbamoyl halides and/or phosphinyl halides, especially carbamyl- and/or phosphinyl chlorides. The reaction of the acids (V) and/or their reactive derivatives with compounds (I), in which **G** is hydrogen, preferably occurs in the presence of auxiliary bases in solvents and under conditions as they are described in method (a).

Compounds of formula (I), wherein **G** represents a carbamoyl residue according to the definition (G2b) with the proviso that $r = 0$, the grouping is



can also be produced, aside from the methods (a) and (d)

(e) by reacting compounds of formula (I), in which **G** is hydrogen with a carbonyl group transmitter to an intermediate product and subsequently reacting this directly with a primary or secondary amine with the formula (VI)

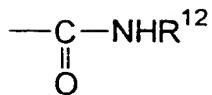


wherein R^{12} and R^{14} and/or the grouping $\text{---NR}^{12}\text{R}^{14}$ have the meanings according to the above definitions without having to purify or isolate the intermediate product.

Bis-trichloromethyl carbonate (triphosgene) and carbonyldiimidazol have been proven as particularly reactive carbonyl group transmitters. The reaction of compounds of formula (I), wherein G is hydrogen, with triphosgene and/or carbonyldiimidazol are typically conducted in an absolute, inert solvent in the presence of a tertiary organic amine as an auxiliary base in such a manner that the solution of compounds (I) and the auxiliary base are slowly poured into a solution of an equivalent amount of carbonyl group transmitter. Thereby, the reaction requires molar ratios of 1 : 1 for the reaction of compound (I) and carbonyldiimidazol, and, in contrast, a ratio of 1 : 0.35 for the use of triphosgene. After complete reaction of the components to the intermediate product, compound (VI) is added in stoichiometric amounts or in excess as a solution or a solid and the reaction is typically completed at elevated temperature. Suitable inert solvents are, for example hydrocarbons such as hexane, heptane, benzene, toluene, xylene, chlorinated hydrocarbons (for example dichloromethane, chloroform, 1,2-dichloroethane, trichloroethylene), ethers (for example diethyl ether, tetrahydrofuran, dioxane), esters such as ethyl acetate, butyl acetate, acetonitrile or polar aprotic solvents such as formamide or dimethylformamide. Pure solvents as well as mixtures can be used diversely. Sometimes it is of advantage to carry out the first partial reaction at low temperature in a low-viscosity, highly-volatile solvent and to remove the solvent after formation of the intermediate and replace it by a higher boiling solvent.

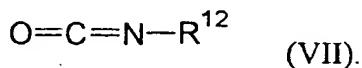
Amines such as for example triethylamine, ethyl diisopropylamine, tributylamine, N-methylmorpholine or pyridine are suitable as auxiliary bases. If compounds (I) or (VI) are used as salts, the amount of the auxiliary base is increased accordingly. The reaction temperatures can lie in between -40°C and 50°C for the first partial reaction, preferably at 0°C to 30°C, and between 0°C and 150°C for the second partial reaction, preferably at 20°C to 120°C.

Compounds of formula (I), wherein G represents a carbamoyl residue according to the definition (G2b) with the proviso that r = 0 and R¹⁴ = hydrogen, the grouping is



can also be produced, aside from methods (a), (d) and (e)

(f) by reacting the compounds of formula (I) in which G is hydrogen, with an isocyanate of formula (VII) in which R¹² has the meaning according to the above definition



Reaction of the compounds of formula (I), in which G is hydrogen, with the isocyanates of formula (VII) are conducted thereby in an absolute, inert solvent which can be a hydrocarbon such as pentane, hexane, heptane, benzene, toluene, or xylene, chlorinated hydrocarbons (such as dichloromethane, chloroform, 1,2-dichloroethane, trichloroethylene), ethers (for example, diethyl ether, tetrahydrofuran, dioxane), esters such as ethyl acetate, butyl acetate, or polar aprotic solvents such as formamide or dimethylformamide. mixtures of various solvents can also be used. Thereby, the reaction temperatures can vary in the region from -20°C to 150°C, but preferably lie at 20°C to 100°C.

As already mentioned, the compounds of formula (I), wherein G is hydrogen, are themselves compounds with tumor growth inhibiting activity and/or cytostatic and immunosuppressive effectiveness. However, independent of their therapeutic applicability, they also represent useful intermediate compounds for the production of a multitude of other compounds according to the invention corresponding to (c) to (f).

They themselves can, in principle, be produced according to method A by reacting a carboxylic acid of formula (II) with amines of formula (III) in which G is hydrogen as described above. However, since the compounds of formula (III) with hydrogen as G represent α,ω -diamines, the formation of product mixtures is always to be expected in their reaction with carboxylic acids (II) or their reactive derivatives making a subsequent separation necessary.

In contrast, compounds of formula (I), in which G is hydrogen, are essentially more advantageously produced from other compounds of formula (I), in which G is a selectively cleavable group under mild conditions, i.e. corresponds to a nitrogen protective group.

Among the compounds according to formula (I) with tumor growth inhibiting and/or cytostatic or immunomodulatory and/or immunosuppressive properties, are compounds in which G represents a 4-methoxybenzyl group, a triphenylmethyl group, a methoxy- and/or ethoxycarbonyl group, a tert-butoxycarbonyl group, an allyloxycarbonyl group or a trifluoroacetyl group. Thus, compounds of formula (I) with a 4-methoxybenzyl group as G are transformed into compounds of formula (I) with hydrogen as G by selective oxidation with ammonium-cer(IV)-nitrate for example. The cleavage of simple alkoxy carbonyl groups such as the methoxy- or ethoxycarbonyl group as well as the trifluoroacetyl group as G in compounds of formula (I) succeed by alkali hydrolysis under mild conditions without cleaving the A and D linked amide function. This is suitably valid for the cleavage of the triphenylmethyl group and the tert-butoxycarbonyl group as G in compounds of formula (I), which occurs in acidic medium under mild conditions. Finally, compounds of formula (I) with an allyloxycarbonyl group as G can be converted into such with hydrogen as G in neutral medium with palladium catalyst. All these methods are fully familiar to the person skilled in the art, and are furthermore also documented in monographs (see for example Greene, Wuts, Protective Groups in Organic Synthesis, New York, 1991).

Compounds of formula (I), wherein R⁴ is an alkyl, alkenyl, alkinyl or cycloalkyl residue according to the above definition can also be produced, aside from the methods (a) and (b),

(g) by reacting compounds of formula (I), wherein R⁴ is hydrogen, with a suitable alkylation agent of formula (VIII)



wherein R⁴ is an alkyl, alkenyl, alkinyl or cycloalkyl residue according to the above definition and L is a suitable nucleofuge, i.e. for example a halogen atom such as chlorine, bromine or iodine or a sulfonic acid ester of an alcohol. Preferred sulfonic acid esters (VIII) contain a methylsulfonyloxy residue, trifluoromethanesulfonyloxy-, p-toluenesulfonyloxy-, p-bromobenzenesulfonyloxy- or m-nitrobenzenesulfonyloxy residue as L.

As an amide alkylation in the presence of tertiary amino groups, this reaction requires the use of strong auxiliary bases such as potassium-tert-butylate, sodium hydride, potassium hydride or butyl lithium in aprotic, inert solvents. Such solvents can be for example aliphatic or aromatic hydrocarbons (pentane, hexane, heptane, benzene, toluene), ethers (for example, tetrahydrofuran, dioxane) or polar solvents such as dimethylsulfoxide, dimethylformamide or N-methylpyrrolidone. Depending on the reactivity of the educts, the reaction temperatures can lie between -40°C and 140°C preferably between -20°C and 80°C.

The compounds of formula (I) produced according to the methods (a) to (g) can be isolated and purified in a known manner, for example by subjecting the residue after distillation of the solvent to partition, extraction, re-precipitation or re-crystallization or another purification method. For this, column chromatography on a suitable support or preparative, middle or high pressure liquid chromatography are preferred for this.

The compounds (I) are first normally obtained in form of their free bases or their hydrates or solvates, depending on the type of isolation and purification. Their addition salts with pharmaceutically suitable acids are obtained in a typical manner by converting the base with the desired acid in a suitable solvent. Depending on the number of basic centers of compound (I), one or more equivalent acids per mole of base can be bound.

Suitable solvents are, for example, chlorinated hydrocarbons such as dichloromethane or chloroform; ethers such as diethyl ether, dioxane or tetrahydrofuran; acetonitrile; ketones such as acetone or ethyl methyl ketone; esters such as methyl acetate or ethyl acetate or low molecular alcohols such as methanol, ethanol or isopropanol; and water. Pure solvents as well as mixtures of two or three solvents can also be used. The salts can be isolated by crystallization, precipitation or the evaporation of the solvent. Thereby, they optionally accumulate as hydrates or solvates.

The bases can be recovered from the salts by alkalization, for example with aqueous ammonia solution, alkali carbonate or diluted sodium hydroxide solution.

The following listed compounds and/or their pharmaceutically acceptable salts, if not already concretely labelled as such, are particularly preferred.

N-[4-(1-methylsulfonylpiperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide,

N-{4-[1-(2-naphthylsulfonyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-{4-[1-(2-naphthylsulfonyl)-piperidin-4-yl]-butyl}-5-(pyridin-3-yl)-2,4-pentadienoic acid amide,

N-{4-[1-(1-naphthylaminocarbonyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-[4-(1-diphenylaminocarbonyl-piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide,

N-[4-(1-diphenylaminocarbonyl-piperidin-4-yl)-butyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide,

N-{4-[1-(10,11-dihydrodibenzo[b,f]azepin-5-yl-carbonyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-[4-(1-diphenylphosphinoyl-piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide,

N-[4-(1-acetyl piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide,

N-[4-(1-diphenylacetyl-piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide,

N-{4-[1-(3,3-diphenylpropionyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-[4-(1-benzoylpiperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide,

N-[4-(1-benzoylpiperidin-4-yl)-butyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide,

N-{4-[1-(9-oxo-9H-fluoro-4-yl-carbonyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-{4-[1-(phenylpyridin-3-yl-methyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-{4-[1-(phenylpyridin-4-yl-methyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-{4-[1-(6,11-dihydrodibenzo[b,e]oxepin-11-yl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-{4-[1-(6,11-dihydrodibenzo[b,e]thiepin-11-yl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-[7-(1-diphenylmethylpiperidin-4-yl)-heptyl]-3-(pyridin-3-yl)-acrylamide,

N-[8-(1-diphenylmethylpiperidin-4-yl)-octyl]-3-(pyridin-3-yl)-acrylamide,

N-[3-(1-diphenylmethylpiperidin-4-yloxy)-propyl]-3-(pyridin-3-yl)-acrylamide,

N-[3-(1-benzylpiperidin-4-yloxy)-propyl]-3-(pyridin-3-yl)-acrylamide,

N-[2-(1-diphenylmethylpiperidin-4-yl)-ethyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide,

N-[4-(1-diphenylmethylpiperidin-4-yl)-butyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide,

N-[5-(1-diphenylmethylpiperidin-4-yl)-pentyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide or

N-[6-(1-diphenylmethylpiperidin-4-yl)-hexyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide.

SYNTHETIC EXAMPLES

for the end products of the invention according to formula (I)

In the following production examples for the end products, the abbreviations stand for the following terms:

MP = melting point,

RT = room temperature,

THF = tetrahydrofuran,

DMF = dimethylformamide,

CDI = carbonyldiimidazol,

abs. = absolute,

EDC = N-(3-dimethylaminopropyl)-N'-ethyl-carbodiimide hydrochloride,

HOBT = 1-hydroxybenzotriazol,

TEA = triethylamine.

¹H-NMR-Spectrum = proton resonance spectrum, taken at 100 MHz. The chemical shifts are given in ppm against TMS as a standard ($\delta = 0.0$), whereby

s = singlet,

d = doublet,

t = triplet,

dt = doublet-triplet,

m = multiplet,

ar = aromatic,

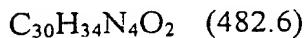
py = pyridine.

Example 1

N-{4-[1-(diphenylaminocarbonyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide (substance 199)

6.5 g (18.0 mmol) N-[4-(piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide dihydrochloride (K22.142) and 5.77 ml (41.4 mmol) TEA are placed in 70 ml abs. dichlormethane and cooled to ca. 0°C under moisture exclusion. 4.58 g (19.8 mmol)

N,N-diphenylcarbamic acid chloride are dissolved in 20 ml abs. dichlormethane and added dropwise. The mixture is stirred at RT overnight without further cooling. 4 ml (28.7 mmol) TEA are added and the red colored suspension is stirred a further 2 hours at RT. Subsequently, the batch is washed with 80 ml water. The organic phase is dried over sodium sulfate and the solvent is removed under vacuum. The residue is chromatographically purified over silica gel with CHCl₃/CH₃OH (98/2) and crystallized twice, each from: 60 ml acetic acid ethyl ester, after drawing off the solvent. Beige colored crystals with a MP of 132-134°C; yield: 5.3 g (60%).



IR-spectrum (KBr): $\nu(\text{NH})$ 3300 cm^{-1}
 $\nu(\text{C=O})$ 1660 cm^{-1}

¹H-NMR-spectrum (CDCl_3): 0.60 - 1.75 (11H, m, piperidine, piperidine-(CH_2)₃)
 2.40 - 2.85 (2H, m, piperidine)
 3.33 (2H, dt, CONHCH_2 , $J=6.5$ Hz.
 $J=12.7$ Hz)
 3.85 - 4.20 (2H, m, piperidine)
 5.95 - 6.20 (1H, m, NH)
 6.42 (1H, d, $\text{CH}=\text{CHCO}$, $J=15.7$ Hz)
 6.90 - 7.45 (11H, m, ar, py)
 7.59 (1H, d, $\text{CH}=\text{CHCO}$, $J=15.7$ Hz)
 7.65 - 7.90 (1H, m, py)
 8.45 - 8.60 (1H, m, py)
 8.65 - 8.85 (1H, m, py)

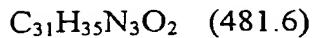
Example 2

**N-[4-(1-diphenylacetyl-piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide
(substance 150)**

Production occurs analogously to example 1. However, no TEA is subsequently added.

Batch size: 5.0 g (13.9 mmol) N-[4-(piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide dihydrochloride (substance 14 as a dihydrochloride), 5.8 ml (41.6 mmol) TEA and 3.9 g (15.2 mmol) diphenylacetic acid chloride,

In the purification, this is washed twice, each with 50 ml water. The chromatographic purification is carried out with CHCl₃/CH₃OH (97/3 to 95/5). The residue is first crystallized twice, each from 15 ml acetic acid ethyl ester and then from 18 ml ethanol/diethyl ether (5/1). Colorless crystals remain with a MP of 161°C; yield: 3.6 g (53%).



| | |
|--------------------|------------------------------------|
| IR-spectrum (KBr): | v(NH) 3280 cm ⁻¹ |
| | v(C=O) 1665, 1530 cm ⁻¹ |
| | v(C=C) 1615 cm ⁻¹ |

| | |
|---------------------------------------------------|----------------------------------------------------------------------------------|
| ¹ H-NMR-spectrum (CDCl ₃): | 0.50 - 1.85 (11H, m, piperidine, piperidine-(CH ₂) ₃) |
| | 2.40 - 3.10 (2H, m, piperidine) |
| | 3.32 (2H, dt, CONHCH ₂ , J=6.5 Hz. J=12.6 Hz) |
| | 3.80 - 4.05 (1H, m, piperidine) |
| | 4.55 - 4.80 (1H, m, piperidine) |
| | 5.23 (1H, Ar ₂ CH) |

6.10 - 6.35 (1H, m, NH)
6.44 (1H, d, CH=CHCO, J=15.7 Hz)
7.10 - 7.45 (11H, m, ar, py)
7.59 (1H, d, CH=CHCO, J=15.7 Hz)
7.60 - 7.85 (1H, m, py)
8.50 - 8.65 (1H, m, py)
8.65 - 8.80 (1H, m, py)

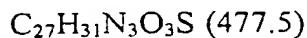
Example 3

N-{4-[1-(2-naphthyl-sulfonyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide (substance 219)

Production occurs analogously to example 2.

Batch size: 6.0 g (16.6 mmol) N-[4-(piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide dihydrochloride (substance 14 as dihydrochloride), 5.6 ml (40.0 mmol) TEA and 2.5 g (11.0 mmol) naphthalin-2-sulfonic acid chloride in 70 ml abs. dichlormethane.

In the work up, this is washed twice, each with 70 ml water. The chromatographic purification is carried out with CHCl₃/CH₃OH (95/5 to 94/6). The residue is crystallized from 30 ml acetic acid ethyl ester. Repeated chromatographic purification with CHCl₃/CH₃OH (95/5). Yield: 2.7 g (57%); amorphic solid with a MP of 85-87°C.



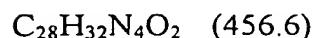
| | | |
|--------------------|-------------|-----------------------------|
| IR-spectrum (KBr): | ν (NH) | 3320 cm ⁻¹ |
| | ν (C=O) | 1690, 1560 cm ⁻¹ |
| | ν (C=C) | 1640 cm ⁻¹ |

¹H-NMR-spectrum (CDCl_3): 0.90 - 1.95 (11H, m, piperidine, piperidine-(CH_2)₃)
2.10 - 2.50 (2H, m, piperidine)
3.34 (2H, dt, CONHCH_2 , $J=6.5$ Hz, $J=12.5$ Hz)
3.65 - 4.00 (2H, m, piperidine)
5.85 - 6.15 (1H, m, NH)
6.46 (1H, d, $\text{CH}=\text{CHCO}$, $J=15.7$ Hz)
7.15 - 8.10 (9H, m, ar, py.
 $\text{CH}=\text{CHCO})$
8.33 (1H, s, Ar)
8.50 - 8.65 (1H, m, py)
8.65 - 8.80 (1H, m, py)

Example 4

N-[4-{1-(1-naphthylaminocarbonyl)-piperidin-4-yl}-butyl]-3-(pyridin-3-yl)-acrylamide (substance 195)

2.35 g (13.9mmol) 1-naphthyl isocyanate are dissolved in 10 ml abs. THF and a solution of 4.0 g (13.9 mmol) N-[4-(piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide (substance 14) in 30 ml abs. THF is added dropwise at RT under moisture exclusion. After ca. one hour, a white precipitate forms and the suspension is stirred at RT overnight. The solid is drawn off, chromatographically purified over silica gel with $\text{CHCl}_3/\text{CH}_3\text{OH}$ (95/5 to 93/7) and crystallized from isopropanol after removal of the solvent. Colorless crystals remain with a MP of 198-200°C; yield: 2.2 g (34%).



IR-spectrum (KBr): $\nu(\text{NH})$ 3240 cm^{-1}

| | |
|-------------|-----------------------------|
| ν (C=O) | 1660, 1560 cm ⁻¹ |
| ν (C=C) | 1615 cm ⁻¹ |

¹H-NMR-spectrum (CDCl₃): 1.00 - 1.95 (11H, m, piperidine, piperidine-(CH₂)₃)
2.75 - 3.15 (2H, m, piperidine)
3.37 (2H, dt, CONHCH₂, J=6.5 Hz.
J=12.7 Hz)
3.95 - 4.25 (2H, m, piperidine)
5.75 - 6.05 (1H, m, NH)
6.42 (1H, d, CH=CHCO, J=15.6 Hz)
6.70 (1H, s, NH)
7.20 - 8.00 (10H, m, ar, py.
CH=CHCO)
8.50 - 8.65 (1H, m, py)
8.65 - 8.80 (1H, m, py)

Example 5

N-[4-{1-(6,11-dihydro-dibenzo[b,e]thiepin-11-yl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide (substance 136)

7.02 g (21.5 mmol) N-[4-(piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide dihydrochloride (substance 14 as a dihydrochloride) are suspended in 100 ml abs. dichlormethane and added to 7.08 g (70.0 mmol) TEA. The mixture is cooled to ca. 0°C under moisture exclusion and a solution of 5.30 g (21.5 mmol) 11-chlor-6,11-dihydro-dibenzo[b,e]thiepine in 10 ml abs. dichlormethane is added dropwise. The mixture is stirred for 24 hours at RT without further cooling. Subsequently, the batch is washed with 50 ml 10% sodium hydroxide solution and 30 ml water. The organic

100

phase is dried over sodium sulfate and the solvent is removed under vacuum. The red brown residue is chromatographically purified three times over silica gel with CHCl₃/CH₃OH (100/0, 97/3 and 96/4 to 94/6). Subsequently, a further purification occurs by means of MPLC with CHCl₃/CH₃OH (98/2). Yield: 0.5 g (5%) of a brittle, vitreous solid with a MP of 89-91°C.

C₃₁H₃₅N₃OS (497.7)

IR-spectrum (KBr):

| | |
|---------|-----------------------------|
| ν (NH) | 3280 cm ⁻¹ |
| ν (C=O) | 1660, 1550 cm ⁻¹ |
| ν (C=C) | 1620 cm ⁻¹ |

¹H-NMR-spectrum (CDCl₃):

| |
|----------------------------------------------------------------------------------|
| 0.90 - 2.00 (13H, m, piperidine, piperidine-(CH ₂) ₃) |
| 2.55 - 2.95 (2H, m, piperidine) |
| 3.20 - 3.60 (3H, m, CONH <u>CH₂</u> . SCH ₂) |
| 4.03 (1H, Ar ₂ CH) |
| 6.10 - 6.35 (1H, m, NH) |
| 5.95 - 6.30 (1H, m, SCH ₂) |
| 6.44 (1H, d, CH= <u>CHCO</u> , J=15.7 Hz) |
| 6.85 - 7.40 (9H, m, ar, py) |
| 7.61 (1H, d, CH= <u>CHCO</u> , J=15.7 Hz) |
| 7.65 - 7.85 (1H, m, py) |
| 8.50 - 8.65 (1H, m, py) |
| 8.65 - 8.80 (1H, m, py) |

Example 6

N-[4-(1-diphenylmethyl-piperidin-4-yl)-butyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide (substance 70)

3.85 g (22.0 mmol) 5-(3-pyridyl)-2,4-pentadienoic acid are suspended in 90 ml abs. dichlormethane and after addition of three drops of pyridine, cooled to ca. 0°C in an ice bath under moisture exclusion. 3.8 g (30.0 mmol) oxalyl chloride are added dropwise and the mixture is stirred at RT overnight. Subsequently, the solvent and excess oxalyl chloride is distilled off on a rotary evaporator. In order to completely remove the oxalyl chloride, the residue is dried for two hours under high-vacuum. The acid chloride obtained in this manner is suspended in 50 ml abs. dichloromethane and cooled to ca. 0°C in an ice bath under moisture exclusion. 6.44 g (20.0 mmol) 4-(1-diphenylmethyl-piperidin-4-yl)-butylamine are dissolved in 40 ml abs. dichlormethane and added dropwise to this suspension. After complete addition, the ice bath is removed and the reaction is stirred for an additional two hours at RT. The mixture is subsequently washed with 10% sodium hydroxide solution. The organic phase is washed twice, each with 40 ml water, dried over sodium sulfate and the solvent is removed under vacuum. The residue is chromatographically purified over silica gel with CHCl₃/CH₃OH (98/2 to 95/5) and crystallized twice from 250 ml and 200 ml acetonitrile after drawing off the solvent. Beige colored crystals with a MP of 164-166°C; yield: 4.7 g (49%).



IR-spectrum (KBr): ν (NH) 3280 cm⁻¹

ν (C=O) 1650, 1550 cm⁻¹

ν (C=C) 1600 cm⁻¹

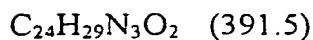
¹H-NMR-spectrum (CDCl₃): 1.00 - 2.00 (13H, m, piperidine,
piperidine-(CH₂)₃)
 2.70 - 3.00 (2H, m, piperidine)
 3.34 (2H, dt, CONHCH₂, J=6.6 Hz.
 J=12.8 Hz)

4.21 (1H, s, Ar₂CH)
5.50 - 5.75 (1H, m, NH)
6.44 (1H, d, CH=CH, J=14.7 Hz)
6.75 - 6.95 (2H, m, CH=CH)
7.05 - 7.50 (12H, m, ar, py.
CH=CH)
7.65 - 7.85 (1H, m, py)
8.45 - 8.55 (1H, m, py)
8.60 - 8.75 (1H, m, py)

Example 7

N-[4-(1-benzoylpiperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide (substance 159)

5.1 g (36.2 mMol) benzoyl chloride are dissolved in 150 ml abs. dichlormethane and cooled to ca. 0°C under moisture exclusion. 10.4 g (36.2 mmol) N-[4-(piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide (substance 14) are dissolved in 50 ml abs. dichlormethane and added dropwise under ice cooling. The mixture is stirred overnight at RT without further cooling. Subsequently, the suspension is added to 60 ml 2 M sodium hydroxide and extracted twice, each with 80 ml dichlormethane. The combined organic phases are washed twice, each with 60 ml water, dried over sodium sulfate and the solvent is removed under vacuum. The residue is chromatographically purified over silica gel with CHCl₃/CH₃OH (97/3 to 95/5) and recrystallized from 75 ml acetonitrile. Colorless crystals with a MP of 100-102°C are recovered; yield: 9.8 g (69%).



| | | |
|--------------------|-------------|-----------------------------|
| IR-spectrum (KBr): | ν (NH) | 3280 cm ⁻¹ |
| | ν (C=O) | 1670, 1545 cm ⁻¹ |

$\nu (\text{C}=\text{C}) \quad 1630 \text{ cm}^{-1}$

¹H-NMR-spectrum (CDCl_3): 0.80 - 2.00 (11H, m, piperidine, piperidine-(CH_2)₃)
2.55 - 4.00 (5H, m, piperidine, CONHCH_2)
4.40 - 4.90 (1H, piperidine)
6.00 - 6.25 (1H, m, NH)
6.48 (1H, d, $\text{CH}=\underline{\text{CH}}\text{CO}$, $J=15.7$ Hz)
7.15 - 7.95 (8H, m, ar, py.
 $\underline{\text{CH}}=\text{CHCO}$)
8.50 - 8.65 (1H, m, py)
8.65 - 8.80 (1H, m, py)

Example 8

N-(1-diphenylmethyl-azetin-3-ylmethyl)-3-(pyridin-3-yl)-acrylamide (substance 1)

Production occurs analogously to example 6.

Batch size: 4.3 g (28.7 mmol) 3-(3-pyridyl)-acrylic acid, 6.7 ml (78.4 mmol) oxalyl chloride and 6.6 g (26.1 mmol) (1-diphenylmethyl-azetidin-3-ylmethyl)-amine.

In the work up, the reaction mixture is washed with 10% sodium hydroxide solution. The aqueous phase is extracted twice, each with 50 ml dichlormethane. The combined organic phases are dried over sodium sulfate and the solvent is removed under vacuum. The residue is chromatographically pre-purified over silica gel with $\text{CHCl}_3/\text{CH}_3\text{OH}$ (98/2 to 95/5) and subsequently purified by two-fold flash-chromatography with

CHCl₃/CH₃OH (99/1 to 95/5). After drawing off the solvent, an amorphous solid remains with a MP of 72-74°C; yield: 0.75 g (7%).



| | |
|---------------------------------------------------|-------------------------------------------------------|
| IR-spectrum (KBr): | ν (NH) 3320 cm ⁻¹ |
| | ν (C=O) 1680, 1570 cm ⁻¹ |
| | ν (C=C) 1640 cm ⁻¹ |
| ¹ H-NMR-spectrum (CDCl ₃): | 2.40 - 2.80 (1H, m, azetidine) |
| | 2.80 - 3.10 (2H, m, azetidine) |
| | 3.10 - 3.40 (2H, m, azetidine) |
| | 3.60 (2H, dd, CONH <u>CH</u> ₂ , J=5.7 Hz) |
| | 4.36 (1H, Ar2CH) |
| | 6.45 - 6.75 (1H, m, NH) |
| | 6.50 (1H, d, CH= <u>CH</u> CO, J=15.7 Hz) |
| | 7.00 - 7.50 (11H, m, ar, py) |
| | 7.62 (1H, d, <u>CH</u> =CHCO, J=15.7 Hz) |
| | 7.65 - 7.90 (1H, m, py) |
| | 8.50 - 8.70 (1H, m, py) |
| | 8.70 - 8.85 (1H, m, py) |

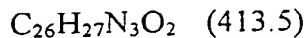
Example 9

**N-(4-diphenylmethyl-morpholin-2-ylmethyl)-3-(pyridin-3-yl)-acrylamide
(substance 250)**

Production occurs analogously to example 6.

Batch size: 2.3 g (15.6 mmol) 3-(3-pyridyl)-acrylic acid, 5.4 g (42.5 mmol) oxalyl chloride and 3.6 g (14.7 mmol) 2-aminomethyl-4-diphenylmethylmorpholine.

In the work up, 40 ml 10% sodium hydroxide solution are added to the reaction solution. The aqueous phase is extracted with 15 ml dichlormethane. The combined organic phases are washed twice, each with 15 ml water, dried over sodium sulfate and the solvent is removed under vacuum. The residue is chromatographically purified three times over silica gel with CHCl₃/CH₃OH (95/5, 90/10 and 90/10). After drawing off the solvent, an amorphous solid remains with a MP of 71-74°C; yield: 0.8 g (13%).



| | |
|---------------------------------------------------|------------------------------------------------------|
| IR-spectrum (KBr): | ν (NH) 3270 cm ⁻¹ |
| | ν (C=O) 1655, 1540 cm ⁻¹ |
| | ν (C=C) 1620 cm ⁻¹ |
| ¹ H-NMR-spectrum (CDCl ₃): | 1.70 - 2.30 (2H, m, morpholine) |
| | 2.55 - 2.90 (2H, m, morpholine) |
| | 3.00 - 3.35 (1H, m, morpholine) |
| | 3.50 - 4.00 (4H, m, CONH <u>CH₂</u> , |
| | morpholine) |
| | 4.20 (1H, Ar ₂ CH) |
| | 6.00 - 6.25 (1H, m, NH) |
| | 6.47 (1H, d, CH=u <u>CHCO</u> , J=15.7 Hz) |
| | 7.00 - 7.55 (11H, m, ar, py) |
| | 7.60 (1H, d, CH=u <u>CHCO</u> , J=15.7 Hz) |
| | 7.65 - 7.90 (1H, m, py) |
| | 8.50 - 8.70 (1H, m, py) |
| | 8.70 - 8.80 (1H, m, py) |

Example 10

N-{4-[1-(9-oxo-9H-fluoren-4-yl-carbonyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide (substance 178)

5.0 g (20.0 mmol) 95% 9-fluoren-4-carboxylic acid chloride are dissolved in 70 ml abs. dichlormethane and 6.5 g (18.2 mmol) N-[4-(piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide dihydrochloride (substance 14 as a dihydrochloride) are added. The mixture is cooled to ca. 0°C under moisture exclusion and 4.0 g (40.0 mmol) TEA dissolved in 10 ml abs. dichlormethane are added dropwise. The batch is stirred at RT overnight without further cooling. In the work up, 150 ml 10% sodium hydroxide solution are added to the reaction solution and this is extracted by shaking. The organic phase is washed with 100 ml water, dried over sodium sulfate and the solvent is removed under vacuum. The residue is pre-purified over silica gel with CHCl₃/CH₃OH (96/4 to 95/5) and subsequently purified by flash-Chromatography with CHCl₃/CH₃OH (95/5). After drawing off the solvent, the product remains as a yellow vitreous solid with a MP of 80-82°C; yield: 2.3 g (25%).

$$\text{C}_{31}\text{H}_{31}\text{N}_3\text{O}_3 \quad (493.6)$$

| | | |
|--------------------|-------------|-----------------------------|
| IR-spectrum (KBr): | ν (NH) | 3320 cm^{-1} |
| | ν (C=O) | 1730, 1640 cm^{-1} |
| | ν (C=C) | 1620 cm^{-1} |

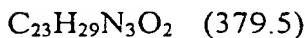
¹H-NMR-spectrum (CDCl_3): 0.70 - 2.05 (11H, m, piperidine,
piperidine- $(\text{CH}_2)_3$)
2.60 - 3.80 (5H, m, piperidine,
CONHCH₂)
4.70 - 5.05 (1H, piperidine)

5.85 - 6.20 (1H, m, NH)
6.47 (1H, d, CH=CHCO, J=15.7 Hz)
7.15 - 7.90 (10H, m, ar, py.
CH=CHCO)
8.50 - 8.65 (1H, m, py)
8.65 - 8.85 (1H, m, py)

Example 11

N-[3-(1-benzyl-piperidin-4-yloxy)-propyl]-3-(pyridin-3-yl)-acrylamide (substance 39)

2.4 g (16.2 mmol) 3-(3-pyridyl)-acrylic acid and 2.3 ml (16.2 mmol) TEA are suspended in 50 ml abs. toluene and a solution of 1.5 ml (15.5 mmol) chloroformic acid ethyl ester in 20 ml abs. toluene are added dropwise under moisture exclusion and light cooling. This yellow suspension is stirred at RT for two hours and then a solution of 3.5 g (14.1 mmol) 3-(1-benzylpiperidin-4-yloxy)-propylamine in 20 ml abs. toluene is added dropwise. The mixture is stirred for two hours at RT and extracted by shaking three times in the heat, each with 10 ml water, 2 M sodium hydroxide and water again. The organic phase is concentrated under vacuum and the orange colored oily residue is chromatographically purified twice over silica gel with CHCl₃/CH₃OH/NH₄OH (90/9/1 and 95/5/0 to 90/10/0) and crystallized from 10 ml acetic acid ethyl ester. Colorless crystals remain with a MP of 100-102°C; yield: 1.9 g (35%).

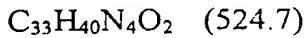


| | | |
|--------------------|-------------|-----------------------------|
| IR-spectrum (KBr): | ν (NH) | 3290 cm ⁻¹ |
| | ν (C=O) | 1650, 1530 cm ⁻¹ |
| | ν (C=C) | 1610 cm ⁻¹ |

¹H-NMR-spectrum (CDCl₃): 1.50 - 2.45 (8H, m, piperidine, C-CH₂-C)
2.70 - 3.00 (2H, m, piperidine)
3.25 - 3.80 (7H, m, piperidine, CONHCH₂, Ar-CH₂, O-CH₂)
6.54 (1H, d, CH=CHCO, J=15.7 Hz)
6.70 - 6.95 (1H, m, NH)
7.25 - 7.50 (6H, m, ar, py)
7.69 (1H, d, CH=CHCO, J=15.7 Hz)
7.80 - 8.00 (1H, m, py)
8.60 - 8.75 (1H, m, py)
8.75 - 8.90 (1H, m, py)

Example 12**N-[6-(1-diphenylmethyl-piperidin-3-yl-carbonyl-amino)-hexyl]-3-(pyridin-3-yl)-acrylamide (substance 103)**

1.79 g (12.0 mmol) 3-(3-pyridyl)-acrylic acid and 4.0 g (39.5 mmol) TEA are suspended in 80 ml abs. dichloromethane and cooled to ca. 0°C under moisture exclusion. 2.2 g (14.3 mmol) 88% HOBT and 2.76 g (14.4 mmol) EDC are added and the mixture is stirred 30 min under ice cooling. 5.6 g (12.0 mmol) 1-diphenylmethyl-piperidin-3-carboxylic acid-(6-amino-hexyl)-amide dihydrochloride are added and the mixture is stirred overnight at RT without cooling. Subsequently, the batch is washed twice with sodium hydroxide with 50 ml 2M sodium hydroxide solution and 70 ml water. The organic phase is dried over sodium sulfate and the solvent is removed under vacuum. The residue is chromatographically purified over silica gel with CHCl₃/CH₃OH (96/4 to 95/5) and crystallized from 70 ml acetonitrile. Colorless crystals remain with a MP of 129-131°C; yield: 3.9 g (62%).



| | | |
|--------------------|-------------|-----------------------------|
| IR-spectrum (KBr): | ν (NH) | 3300 cm ⁻¹ |
| | ν (C=O) | 1640, 1540 cm ⁻¹ |
| | ν (C=C) | 1620 cm ⁻¹ |

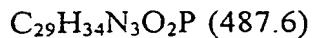
| | |
|---------------------------------------------------|---------------------------------------------------------------------------|
| ¹ H-NMR-spectrum (CDCl ₃): | 1.20 - 2.95 (17H, m, piperidine, C-(CH ₂) ₄ -C) |
| | 3.15 - 3.55 (4H, m, CONHCH ₂) |
| | 4.24 (1H, Ar ₂ CH) |
| | 6.30 - 6.55 (1H, m, NH) |
| | 6.57 (1H, d, CH=CHCO, J=15.7 Hz) |
| | 7.05 - 7.45 (11H, m, ar, py) |

7.62 (1H, d, $\text{CH}=\text{CHCO}$, $J=15.7\text{ Hz}$)
7.65 - 8.00 (2H, m, py. NH)
8.50 - 8.60 (1H, m, py)
8.65 - 8.80 (1H, m, py)

Example 13

N-[4-(1-diphenylphosphinyl-piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide (substance 232)

1.06 ml (5.55 mmol) diphenylphosphinic acid chloride are dissolved in 20 ml abs. THF and cooled to ca. 0°C under moisture exclusion. 2.0 g (5.55 mmol) N-[4-(piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide dihydrochloride (substance 14 as a dihydrochloride) and 2.3 ml (16.6 mmol) TEA are suspended in 90 ml abs. THF and added dropwise under ice cooling. The mixture is stirred for four days at RT without further cooling. Subsequently the solvent is removed under vacuum and the residue is taken up in 70 ml 10% sodium hydroxide solution and extracted twice, each with 100 ml CHCl_3 . The combined organic phases are washed with saturated NaCl solution, dried over sodium sulfate and the solvent is removed under vacuum. The residue is pre-purified over silica gel with $\text{CHCl}_3/\text{CH}_3\text{OH}$ (90/10), subsequently further purified by flash-chromatography with $\text{CHCl}_3/\text{CH}_3\text{OH}$ (90/10) and crystallized from 30 ml acetic acid ethyl ester. Colorless crystals remain with a MP of 154-155°C; yield: 1.04 g (30%).



| | | |
|--------------------|-------------|-----------------------------|
| IR-spectrum (KBr): | ν (NH) | 3260 cm^{-1} |
| | ν (C=O) | $1650, 1550\text{ cm}^{-1}$ |
| | ν (C=C) | 1610 cm^{-1} |

¹H-NMR-spectrum (CDCl_3): 0.90 - 1.80 (11H, m, piperidine,
piperidine-(CH_2)₃)
2.55 - 2.95 (2H, m, piperidine)
3.10 - 3.55 (4H, m, piperidine,
 CONHCH_2)
6.59 (1H, d, $\text{CH}=\text{CHCO}$, $J=15.7$ Hz)
6.55 - 6.80 (1H, m, NH)
7.15 - 8.00 (13H, m, ar, py.
 $\text{CH}=\text{CHCO}$)
8.50 - 8.60 (1H, m, py)
8.60 - 8.80 (1H, m, py)

Example 14

N-[4-(1-benzyl-piperidin-3-yl)-butyl]-3-(pyridin-3-yl)-acrylamide (substance 40)

Production occurs analogously to example 6.

Batch size: 2.6 g (17.4 mmol) 3-(3-pyridyl)-acrylic acid, 1.6 ml (19.0 mmol) oxalyl chloride and 3.9 g (15.8 mmol) 4-(1-benzyl-piperidin-3-yl)-butylamine in 100 ml abs. dichlormethane.

The reaction time is prolonged to 6 hours at RT. In the work up, the batch is washed with 50 ml 1 M sodium hydroxide solution and the aqueous phase is extracted with 50 ml dichlormethane. The combined organic phases are concentrated under vacuum and the residue is chromatographically pre-purified twice over silica gel with $\text{CHCl}_3/\text{CH}_3\text{OH}$ (93/7 and 95/5), subsequently purified further by flash-chromatography with $\text{CHCl}_3/\text{CH}_3\text{OH}$ (95/5 and 97/3) and crystallized from 5 ml acetic acid ethyl ester. Colorless crystals remain with a MP of 80-82°C; yield: 0.9 g (15%).



IR-spectrum (KBr):

| | |
|-------------|-----------------------------|
| ν (NH) | 3300 cm^{-1} |
| ν (C=O) | 1650, 1530 cm^{-1} |
| ν (C=C) | 1610 cm^{-1} |

 ^1H -NMR-spectrum (CDCl_3):

1.00 - 2.10 (13H, m, piperidine,
piperidine-(CH_2)₃)
2.65 - 2.95 (2H, m, piperidine)
3.37 (2H, dt, CONH CH_2 , J=6.5 Hz.
J=12.7 Hz)
3.50 (2H, s, Ar- CH_2)
5.65 - 5.95 (1H, m, NH)
6.46 (1H, d, CH=u CHCO , J=15.6 Hz)
7.10 - 7.40 (6H, m, ar, py)
7.62 (1H, d, CH=u CHCO , J=15.6 Hz)
7.65 - 7.90 (1H, m, py)
8.50 - 8.65 (1H, m, py)
8.70 - 8.80 (1H, m, py)

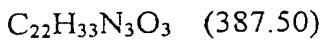
Example 15

**N-[4-(1-tert-Butoxycarbonylpiperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide
(substance 242)**

Production occurs analogously to example 6. TEA is also added dropwise with the addition of the amine.

Batch size: 16.4 g (110 mmol) 3-(3-pyridyl)-acrylic acid, 18.9 g (150 mmol) oxalyl chloride, 25.6 g (100 mmol) 4-(1-tert-butoxycarbonyl-piperidin-4-yl)-butylamine and 10.1 g (100 mmol) TEA in 300 ml abs. dichlormethane.

In the work up, 100 ml 10% sodium hydroxide solution are added to the reaction solution. The aqueous phase is extracted with 30 ml dichlormethane. The combined organic phases are washed twice, each with 25 ml water, and the solvent is removed under vacuum. The residue is dissolved in CHCl₃/CH₃OH (90/10) and filtered through a thin silica gel layer. After drawing off the solvent, the crude product remains as a red oil (44.0 g). For purification, this is chromatographed with CHCl₃/CH₃OH (95/5) on silica gel. Yield: 26.5 g (68 %) as a yellow viscous oil.



| | |
|--------------------|----------------------------------------------|
| IR-spectrum (KBr): | ν (NH) 3250 cm ⁻¹ |
| | ν (C=O) 1670, 1540 cm ⁻¹ |
| | ν (C=C) 1600 cm ⁻¹ |

| | |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------|
| ¹ H-NMR-spectrum (CDCl ₃): | 0.80 - 1.90 (20H, m, piperidine, piperidine-(CH ₂) ₃ , tert, butyl) |
| | 2.30 - 2.90 (2H, m, piperidine) |
| | 3.10 - 3.60 (2H, m, piperidine) |
| | 3.80 - 4.30 (2H, m, CONHC <u>H</u> ₂) |
| | 6.15 - 6.55 (1H, m, NH) |
| | 6.43 (1H, d, CH= <u>C</u> HO, J=15.6 Hz) |
| | 7.05 - 7.85 (2H, m, py) |
| | 7.51 (1H, d, CH= <u>C</u> HO, J=15.6 Hz) |
| | 8.35 - 8.55 (1H, m, py) |
| | 8.55 - 8.70 (1H, m, py) |

Example 16

**N-[4-(piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide dihydrochloride
(substance 14 as a dihydrochloride)**

44.0 g (<113.5 mmol) crude N-[4-[N-(tert-butoxycarbonyl)-piperidin-4-yl]-butyl]-3-(pyridin-3-yl)-acrylamide (substance 242) are dissolved in 400 ml ethanol and added to 26.0 ml conc. hydrochloric acid. The mixture is heated to boiling for three hours and, after cooling, the solvent is removed under vacuum. The yellow residue is crystallized from 500 ml isopropanol. Beige colored crystals remain with a MP of 178-188°C; yield: 32.6 g (90%).

C₁₇H₂₅N₃O · 2 HCl (360.3)

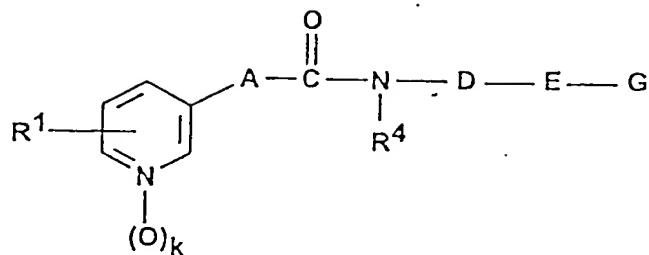
| | | |
|-------------------------------------------------|----------------------------------------------------------------------------------|-----------------------------|
| IR-spectrum (KBr): | v (NH) | 3260 cm ⁻¹ |
| | v (C=O) | 1670, 1545 cm ⁻¹ |
| | v (C=C) | 1630 cm ⁻¹ |
| ¹ H-NMR-spectrum (D ₂ O): | 0.95 - 1.95 (11H, m, piperidine, piperidine-(CH ₂) ₃) | |
| | 2.60 - 3.00 (2H, m, piperidine) | |
| | 3.00 - 3.40 (4H, m, piperidine, CONHCH ₂) | |
| | 6.73 (1H, d, CH=CH <u>CO</u> , J=15.9 Hz) | |
| | 7.41 (1H, d, <u>CH</u> =CHCO, J=15.9 Hz) | |
| | 7.80 - 8.00 (1H, m, py) | |
| | 8.50 - 8.65 (2H, m, py) | |
| | 8.65 - 8.90 (1H, m, py) | |

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The invention is more closely illustrated by means of the further synethesis examples listed in the following Table 2, without restricting the invention.

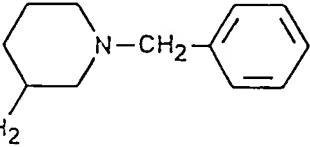
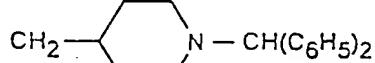
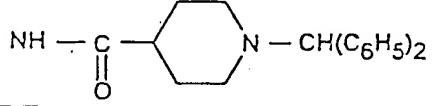
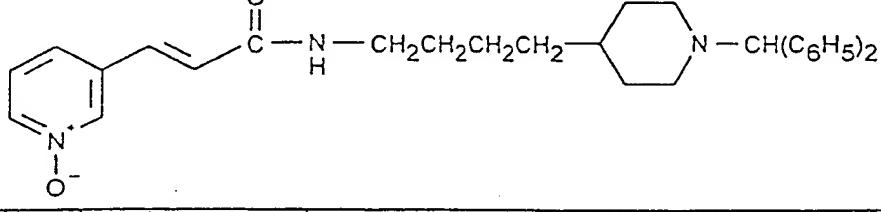
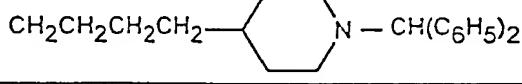
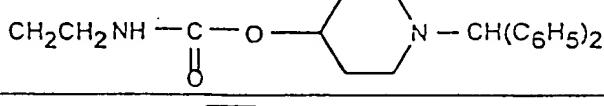
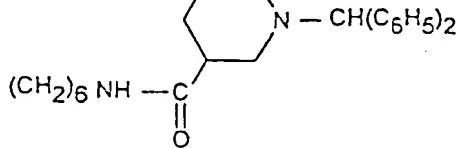
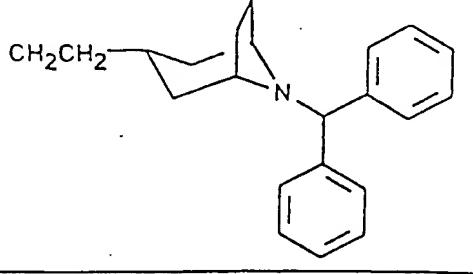
Table 2:

Prepared compounds of
formula (I)

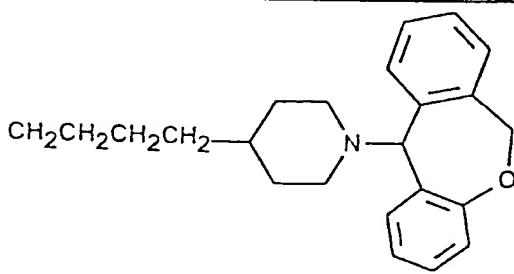
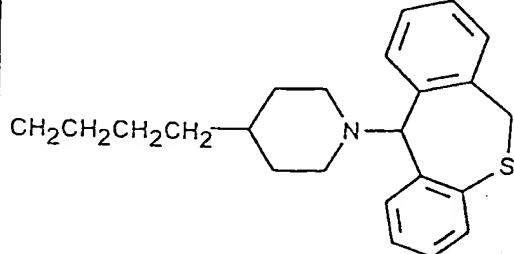
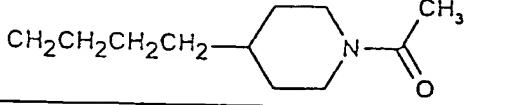
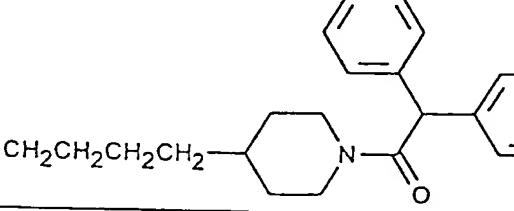
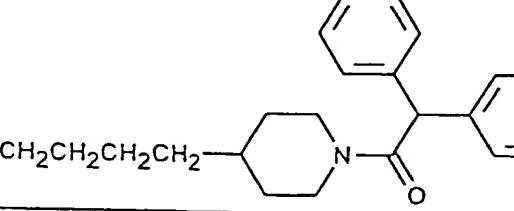
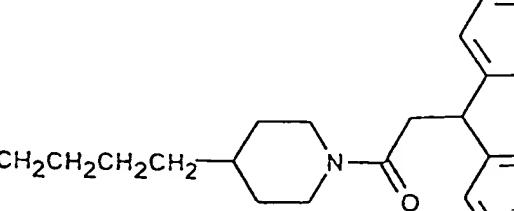


| Nr | R¹ | A | D-E-G | MP [°C] (solvent) ¹ |
|----|----|-------------|-------|-----------------------------------|
| 1 | H | CH=CH | | 72-74 (amorph; CHCl3/MeOH) |
| 4 | H | CH=CH | | 164-165 (EE) |
| 14 | H | CH=CH | | 140-142 (amorph; CH2Cl2) |
| 14 | H | CH=CH | | 178-188 ² (iPrOH) |
| 15 | H | CH=CH-CH=CH | | 197-202 ² (iPrOH) |
| 39 | H | CH=CH | | 100-102 (EE) |

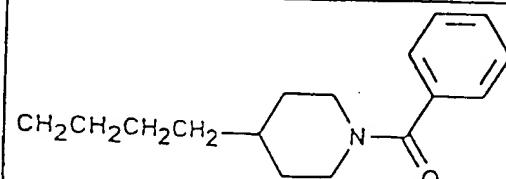
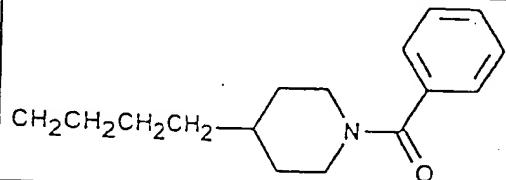
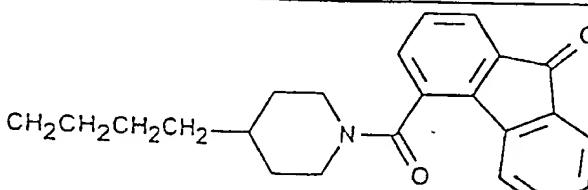
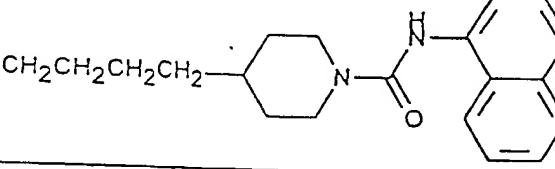
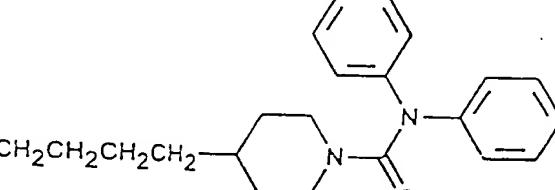
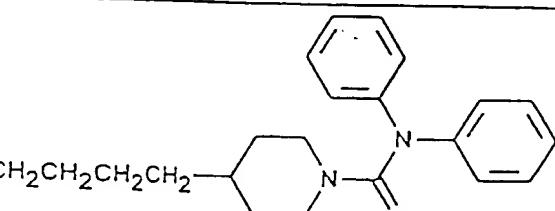
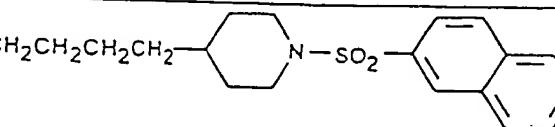
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| Nr | R' | A | D-E-G | MP [°C] (solvent) ^b |
|-----|----|---------------------------------|--------------------------------------------------------------------------------------|-----------------------------------|
| 40 | H | CH=CH |  | 80-82 (EE) |
| 54 | H | CH=CH |  | 135-136 (EE) |
| 59 | H | CH=CH |  | 221-223 (MeOH) |
| 62 | H | CH=CH |  | 139-140 (EE) |
| 63 | | |  | ca. 205 (Zers.) (CHCl3) |
| 65 | H | $\text{CH}=\text{C}$ CN |  | 142-144 (MeCN) |
| 70 | H | CH=CH-CH=CH |  | 164-166 (MeCN) |
| 97 | H | CH=CH |  | 178-180 (EE) |
| 103 | H | CH=CH |  | 129-131 (MeCN) |
| 107 | H | CH=CH |  | 190-192 (MeCN) |

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| Nr | R' | A | D-E-G | MP [°C] (solvent) ¹ |
|-----|----|-------------|--------------------------------------------------------------------------------------|-----------------------------------|
| 134 | H | CH=CH |  | 139-141 (EE) |
| 136 | H | CH=CH |  | 89-91 (amorph; CHCl3/MeOH) |
| 140 | H | CH=CH |  | Harz ² |
| 150 | H | CH=CH |  | 161 (EtOH/Et2O) |
| 151 | H | CH=CH-CH=CH |  | 77-79 (EE/BuCl) |
| 153 | H | CH=CH |  | 105-106 (MeCN/MTBE) |

1(8)

| Nr | R' | A | D-E-G | MP [°C] (solvent) ¹ |
|-----|----|-------------|--------------------------------------------------------------------------------------|-----------------------------------|
| 159 | H | CH=CH |  | 100-102 (MeCN) |
| 162 | H | CH=CH-CH=CH |  | 133-135 (EE/BuCl) |
| 178 | H | CH=CH |  | 80-82 (amorph; CHCl3/MeOH) |
| 195 | H | CH=CH |  | 198-200 (iPrOH) |
| 199 | H | CH=CH |  | 132-134 (EE) |
| 200 | H | CH=CH-CH=CH |  | 146-148 (iPrOH) |
| 219 | H | CH=CH |  | 85-87 (amorph; CHCl3/MeOH) |

- 120 -

| Nr | R' | A | D-E-G | MP [°C] (solvent) ¹ |
|-----|----|-------------|-------|-----------------------------------------------|
| 232 | H | CH=CH | | 154-155 (EE) |
| 242 | H | CH=CH | | OI ³ |
| 243 | H | CH=CH-CH=CH | | 135-136 (EE) |
| 250 | H | CH=CH | | 71-74 (amorph; CHCl ₃ /MeOH) |

Table annotation

¹ MeOH = methanol
EE = ethyl acetate
iPrOH = isopropanol
MeCN = acetonitrile
EtOH = ethanol
Et₂O = diethyl ether
BuCl = 1-chlorobutane
MTBE = methyl tert-butyl ether

² as a dihydrochloride

³ purified by column chromatography

Several examples for the production of the starting compounds are described in the following for the better illustration of the production of the end products.

SYNTHESIS OF THE STARTING COMPOUNDS

Example 1A

4-(1-tert-butoxycarbonyl-piperidin-4-yl)-butan-1-ol

100 g (458 mmol) 4-piperidin-4-yl-butan-1-ol hydrochloride are dissolved in 120 ml water, added to 216 ml (1550 mmol) TEA and cooled to ca. 5-10°C. 122 g (559 mmol) di-tert-butyl dicarbonate are dissolved in 400 ml THF and added dropwise within four hours under further cooling. The mixture is left to stand without further cooling at RT overnight. Subsequently, the THF is removed under vacuum to a large extent and the residue is extracted twice, each with 300 ml and 200 ml CHCl₃ respectively, and the combined organic phases are washed twice, each with 20 ml water. The solvent is removed under vacuum. The residue is dried under high-vacuum and processed further without additional purification. Yield: 136 g (102%).

Example 2A

2-[4-(1-tert-butoxycarbonylpiperidin-4-yl)-butyl]-isoindol-1,3-dione

136 g (<528 mmol) 4-[1-tert-butoxycarbonylpiperidin-4-yl]-butan-1-ol (crude product), 135.3 g (516 mmol) Triphenylphosphine and 75.9 g (516 mmol) phthalimide are suspended in 1800 ml THF and 89.9 g (516 mmol) azodicarboxylic acid diethyl ester are added dropwise within three hours under protective atmosphere and light cooling (to ca. 15°C). The mixture is left to stand at RT overnight without further cooling.

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Subsequently, the solvent is removed under vacuum and the oily residue is dissolved in 500 ml acetic acid ethyl ester and held at 0°C overnight. The sedimented precipitate is filtered and discarded. The solution is concentrated under vacuum and the oily residue is chromatographically purified over silica gel with CHCl₃ and crystallized from 200 ml isopropanol after drawing off the solvent. Colorless crystals remain with a MP of 100-102°C; yield: 108.5 g (57%).

Example 3A

4-(1-tert-butoxycarbonylpiperidin-4-yl)-butylamine

113.0 g (292 mmol) 2-[4-(1-tert-butoxycarbonylpiperidin-4-yl)-butyl]-isoindol-1,3-dione are dissolved in 600 ml ethanol, added to 29.3 g (585 mmol) hydrazine hydrate and heated to boiling for three hours. After cooling the solution, the mixture is filtered and the filtrate is concentrated under vacuum. The residue is dispersed in the heat (ca. 50°C) between 500 ml toluene and 500 ml 10% sodium hydroxide solution. The organic phase is washed once with 50 ml 10% sodium hydroxide solution and twice, each with 50 ml water. The solvent is removed under vacuum and the residue is dried at 70°C under high-vacuum and processed further without additional purification. Yield of colorless oil: 64.0 g (85%).

Example 4A

(1-diphenylmethyl-azetidin-3-ylmethyl)-amine

A solution of 10.0 g (40 mmol) 1-diphenylmethyl-azetidin-3-carbonitrile in 20 ml abs. THF is added dropwise to a suspension of 3.1 g (80 mmol) lithium aluminium hydride in 80 ml abs. THF at RT and stirred overnight. The batch is carefully added to 2 ml ethanol and filtered. The filtrate is concentrated under vacuum and dispersed between CHCl₃ and water. The aqueous phase is extracted twice, each with 50 ml CHCl₃, and

the combined organic phases are dried over sodium sulfate and the solvent is removed under vacuum. The residue is chromatographically purified over silica gel with CHCl₃/CH₃OH/NH₄OH (90/10/0 to 90/10/1). Yield: 5.6 g (55%) of slowly hardening resin.

Example 5A

3-(1-benzylpiperidin-4-yloxy)-propylamine

10.0 g (40.9 mmol) 3-(1-benzylpiperidin-4-yloxy)-propionitrile are dissolved in 100 ml ethanol and added to a spatula tip of Raney-Nickel. The mixture is stirred at RT under hydrogen atmosphere until the uptake of the theoretical amount of hydrogen (ca. two days). The mixture is filtered from the catalyst and the solvent is removed under vacuum. The residue is distilled in a bulb tube apparatus. Yield of colorless oil: 7.5 g (73%).

Example 6A

1-diphenylmethyl-piperidin-3-carboxylic acid hydrochloride

15.7 g (100 mmol) piperidin-3-carboxylic acid ethyl ester and 30.4 g (220 mmol) potassium carbonate are placed in 100 ml DMF and 24.1 g diphenyl methyl bromide are added dropwise. The mixture is stirred overnight at RT and subsequently filtered. The filtrate is concentrated under vacuum and the residue is taken up with 150 ml acetic acid ethyl ester and extracted twice, each with 50 ml 10% hydrochloric acid. The organic phase is discarded and the combined aqueous phases are made basic with 10% sodium hydroxide solution and extracted twice, each with 50 ml acetic acid ethyl ester. The combined organic phases are cooled to ca. 0°C and the precipitated solid is drawn off and dried. Yield: 20.5 g (63%) of the compound 1-diphenylmethyl-piperidin-3-

carboxylic acid ethyl ester with a MP of 166-168°C. This compound is heated to boiling for 8 hours together with 24 ml 20% hydrochloric acid in 100 ml water. After cooling, the precipitate is filtered and crystallized from 70 ml methanol. Yield: 15.6 g (74%).

Example 7A

1-diphenylmethylpiperidin-3-carboxylic acid-(6-amineohexyl)-amide

10.0 g (33.8 mmol) 1-diphenylmethylpiperidin-3-carboxylic acid hydrochloride are reacted analogously to example 6 with 8.6 g (68 mmol) oxalyl chloride to the acid chloride. This is suspended in abs. dichlormethane and added to 6.64 g (30.7 mmol) N-(tert-butoxycarbonyl)-hexanediamine and 3.1 g (30.7 mmol) TEA and stirred at RT overnight. The mixture is subsequently concentrated, taken up in CHCl₃ and washed once with 50 ml 10% sodium hydroxide solution and twice with 30 ml water each. The organic phase is dried over sodium sulfate and the solvent is removed under vacuum. The residue is chromatographically purified over silica gel with CHCl₃/CH₃OH (100/0 to 98/2) and dissolved in 80 ml ethanol. After addition of 6 ml conc. hydrochloric acid, the mixture is heated to boiling for 5 hours. After cooling, the solvent is removed under vacuum and the residue is azeotropically dehydrated twice, each with 30 ml toluene, and subsequently dried under high-vacuum. The resin is further processed without additional purification Yield: 6.8 g (71%).

Example 8A

4-(1-benzylpiperidin-3-yliden)-butyronitrile

77.3 g (188.3 mmol) 3-cyanopropyl-triphenylphosphonium bromide are suspended in 300 ml toluene and added to 22.0 g (191.9 mmol) potassium tert-butylate. The mixture

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is cooled to ca. 0°C under moisture exclusion and a solution of 34.6 g (182.8 mmol) 1-benzyl-3-piperidone in 50 ml toluene is added dropwise under cooling. The batch is left to stand overnight at ca. 0°C and subsequently diluted with 200 ml toluene and washed twice, each with 100 ml water. The organic phase is extracted with 150 ml half concentrated hydrochloric acid. Subsequently, the aqueous phase is made basic with 200 ml 10% sodium hydroxide solution and extracted twice, each with 250 ml toluene. The solvent is removed under vacuum and the residue is chromatographically purified over silica gel with CHCl₃/CH₃OH (97/3). After drawing off the solvent, a light brown oil remains which is processed further without additional purification. Yield: 47.4 g (90%).

Example 9A

4-(1-benzylpiperidin-3-yl)-butylamine

8.0 g (33.3 mmol) 4-(1-benzylpiperidin-3-yliden)-butyronitrile are dissolved in 80 ml ethanol and added to a spatula tip of Raney-Nickel. The mixture is stirred at ca. 50°C under hydrogen atmosphere until consumption of the theoretischen amount of hydrogen to be taken up (ca. 5 days). The mixture is filtrated from the catalyst and the solvent is removed under vacuum. The residue is chromatographically purified twice over silica gel with CHCl₃/CH₃OH/NH₄OH (90/10/1). After drawing off the solvent, a colorless oil remains which is further processed without additional purification. Yield: 3.9 g (47%).

The active ingredients according to the invention can be processed to the desired medicaments in the form of their acid addition salts, hydrates or solvates individually or in combination with each other, optionally under addition of other active ingredients, for the indications tumor treatment or immunosuppression. In the case of the combination of active ingredients according to the invention with other medicinal forms, these can also optionally be separately present next to each other in the medicine packaging, for example as tablets next to viles, depending on the requirements.

Therefore, further subject-matter of the invention is a method for the treatment of the human or animal body in which a compound or compound mixture according to formula (I), wherein the substituents have the above described meaning, is administered for treatment of tumors and/or as a cytostatic agent, cancerostatic agent, immunosuppressing agent, optionally in combination with further cytostatic or immunosuppressive active ingredients or other active ingredients suitable in the named indications.

Furthermore, the invention relates to a compound or compound mixture according to formula (I) for use in a therapeutic method in which the therapeutic use is carried out in connection with one or more medical indications with tumors or for immunosuppression, optimally in combination with further pharmaceuticals suitable in the named indications.

The use of one or more compounds according to formula (I), including (E)-3-(3-pyridyl)-N-[2-(1-benzylpiperidin-4-yl)ethyl]-2-propenamide hydrochloride, for the production of medicaments for the treatment of the human or animal body, especially in connection with one or more medical indications in the treatment of tumors or for immunosuppression, optimally in combination with further pharmaceuticals suitable in these indications or the use of compounds according to formula (I) in a corresponding diagnosis method represent an embodiment according to the invention.

The respective suitable tumor indications are illustrated in the last section of the description in the discussion of the pharmacological test results.

A method for the production of medicaments with an amount of one or more compounds according to formula (I) which are suitable for the processing of these active ingredients together with respective suitable pharmaceutically acceptable carriers and adjuvants for finished medicinal forms equally belongs to the scope of protection according to the invention.

Depending on the medical indication being considered, the respective suitable medical form is selected for the suitable therapeutic application.

The invention also relates to the use of the compounds according to formula (I), including (E)-3-(3-pyridyl)-N-[2-(1-benzylpiperidin-4-yl)ethyl]-2-propenamide hydrochloride, for treatment in the above indications.

The production of the respective suitable medicaments as well as a series of examples of medicinal forms are described in the following for better understanding of the invention.

Therapeutic Administration Forms

The production of medicaments with an amount of one or more compounds according to the invention and/or their use in the application according to the invention occurs in the customary manner by means of common pharmaceutical technology methods. For this, the active ingredients as such or in the form of their salts are processed together with suitable, pharmaceutically acceptable adjuvants and carriers to medicinal forms suitable for the various indications and types of application. Thereby, the medicaments

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can be produced in such a manner that the respective desired release rate is obtained, for example a quick flooding and/or a sustained or depot effect.

Preparations for parenteral use, to which injections and infusions belong, are among the most important systemically employed medicaments for tumor treatment as well as for other indications.

Preferably, injections are administered for the treatment of tumors. These are prepared either in the form of vials or also as so-called ready-to-use injection preparations, for example as ready-to-use syringes or single use syringes in addition to perforation bottles for multiple withdrawals. Administration of the injection preparations can occur in the form of subcutaneous (s.c.), intramuscular (i.m.), intravenous (i.v.) or intracutaneous (i.c.) application. The respective suitable injection forms can especially be produced as solutions, crystal suspensions, nanoparticulate or colloid-disperse systems, such as for example, hydrosols.

The injectable formulations can also be produced as concentrates which can be adjusted with aqueous isotonic dilution agents to the desired active ingredient dosage. Furthermore, they can also be produced as powders, such as for example lyophilisates, which are then preferably dissolved or dispersed immediately before application with suitable diluents. The infusions can also be formulated in the form of isotonic solutions, fat emulsions, liposome formulations, microemulsions and liquids based on mixed micells, for example, based on phospholipids. As with injection preparations, infusion formulations can also be prepared in the form of concentrates to dilute. The injectable formulations can also be applied in the form of continuous infusions as in stationary as well as in out-patient therapy, for example in the form of mini-pumps.

Albumin, plasma expanders, surface active compounds, organic solvents, pH influencing compounds, complex forming compounds or polymeric compounds can be added to the parenteral medicinal forms, especially as substances for influencing the adsorption of the active ingredients to protein or polymers or also with the aim of

decreasing the adsorption of the active ingredient to materials such as injection instruments or packaging materials, for example plastic or glass.

The active ingredients can be bound to nanoparticles in the preparations for parenteral use, for example on finely dispersed particles based on poly(meth)acrylates, polyacetates, polyglycolates, polyamino acids or polyether urethanes. The parenteral formulations can also be constructively modified as depot preparations, for example on the multiple unit principle, where the active ingredients are incorporated in a most finely distributed and/or dispersed, suspended form or as crystal suspensions, or on the single unit principle, where the active ingredient is enclosed in a medicinal form, for example, a tablet or a seed which is subsequently implanted. Often, these implantations or depot medicaments in single unit and multiple unit medicinal forms consist of so-called biodegradable polymers, such as for example, polyether urethanes of lactic and glycolic acid, polyether urethanes, polyamino acids, poly(meth)acrylates or polysaccharides.

Sterilized water, pH value influencing substances, such as for example organic and inorganic acids or bases as well as their salts, buffer substances for setting the pH value, agents for isotonicity, such as for example sodium chloride, monosodium carbonate, glucose and fructose, tensides and/or surface active substances and emulsifiers, such as for example, partial fatty acid esters of polyoxyethylene sorbitan (Tween®) or for example fatty acid esters of polyoxethylene (Cremophor®), fatty oils such as for example peanut oil, soybean oil and castor oil, synthetic fatty acid esters, such as for example ethyl oleate, isopropyl myristate and neutral oil (Miglyol®) as well as polymer adjuvants such as for example gelatin, dextran, polyvinylpyrrolidone, organic solvent additives which increase solubility, such as for example propylene glycol, ethanol, N,N-dimethylacetamide, propylene glycol or complex forming compounds such as for example citrates and urea, preservatives, such as for example hydroxypropyl benzoate and hydroxymethyl benzoate, benzyl alcohol, anti-oxidants,

such as for example sodium sulfite and stabilizers, such as for example EDTA, are suitable as adjuvents and carriers in the production of preparations for parenteral use.

In suspensions, addition of thickening agents to prevent the settling of the active ingredients from tensides and peptizers, to secure the ability of the sediment to be shaken, or complex formers, such as EDTA, ensues. This can also be achieved with the various polymeric agent complexes, for example with polyethylene glycols, polystyrol, carboxymethylcellulose, Pluronics® or polyethylene glycol sorbitan fatty acid esters. The active ingredient can also be incorporated in liquid formulations in the form of inclusion compounds, for example with cyclodextrins. As further adjuvents, dispersion agents are also suitable. For production of lyophilisates, builders are also used, such as for example mannite, dextran, saccharose, human albumin, lactose, PVP or gelatin varieties.

As long as the active ingredients are not incorporated in the liquid medicinal formulations in the form of a base, they are used in the form of their acid addition salts, hydrates or solvates in the preparations for parenteral use.

A further systemic application form of importance is peroral administration as tablets, hard or soft gelatin capsules, coated tablets, powders, pellets, microcapsules, oblong compressives, granules, chewable tablets, lozenges, gums or sachets. These solid peroral administration forms can also be prepared as sustained action and/or depot systems. Among these are medicaments with an amount of one or more micronized active ingredients, diffusions and erosion forms based on matrices, for example by using fats, wax-like and/or polymeric compounds, or so-called reservoir systems. As a retarding agent and/or agent for controlled release, film or matrix forming substances, such as for example ethylcellulose, hydroxypropylmethylcellulose, poly(meth)acrylate derivatives (for example Eudragit®), hydroxypropylmethylcellulose phthalate are suitable in organic solutions as well as in the form of aqueous dispersions. In this connection, so-called bio-adhesive preparations are also to be named in which the

increased retention time in the body is achieved by intensive contact with the mucus membranes of the body. An example of a bio-adhesive polymer is the group of Carbomers®.

For sublingual application, compressives, such as for example non-disintegrating tablets in oblong form of a suitable size with a slow release of active ingredient, are especially suitable. For purposes of a targeted release of active ingredients in the various sections of the gastrointestinal tract, mixtures of pellets which release at the various places are employable, for example mixtures of gastric fluid soluble and small intestine soluble and/or gastric fluid resistant and large intestine soluble pellets. The same goal of releasing at various sections of the gastrointestinal tract can also be conceived by suitably produced laminated tablets with a core, whereby the coating of the agent is quickly released in gastric fluid and the core of the agent is slowly released in the small intestine milieu. The goal of controlled release at various sections of the gastrointestinal tract can also be attained by multilayer tablets. The pellet mixtures with differentially released agent can be filled into hard gelatin capsules.

Anti-stick and lubricant and separating agents, dispersion agents such as flame dispersed silicone dioxide, disintegrants, such as various starch types, PVC, cellulose esters as granulating or retarding agents, such as for example wax-like and/or polymeric compounds on the basis of Eudragit®, cellulose or Cremophor® are used as a further adjuvents for the production of compressives, such as for example tablets or hard and soft gelatin capsules as well as coated tablets and granulates.

Anti-oxidants, sweetening agents, such as for example saccharose, xylite or mannite, masking flavors, aromatics, preservatives, colorants, buffer substances, direct tabletting agents, such as for example microcrystalline cellulose, starch and starch hydrolysates (for example Celutab®), lactose, polyethylene glycols, polyvinylpyrrolidone and dicalcium phosphate, lubricants, fillers, such as lactose or starch, binding agents in the form of lactose, starch varieties, such as for example wheat or corn and/or rice starch,

cellulose derivatives, for example methylcellulose, hydroxypropylcellulose or silica, talcum powder, stearates, such as for example magnesium stearate, aluminum stearate, calcium stearate, talc, siliconized talc, stearic acid, acetyl alcohol and hydrated fats are used.

In this connection, oral therapeutic systems constructed especially on osmotic principles, such as for example GIT (gastrointestinal therapeutic system) or OROS (oral osmotic system), are also to be mentioned.

Effervescent tablets or tabs, both of which represent immediately drinkable instant medicinal forms which are quickly dissolved or suspended in water are among the perorally administratable compressives. Among the perorally administratable forms are also solutions, for example drops, juices and suspensions, which can be produced according to the above given method, and can still contain preservatives for increasing stability and optionally aromatics for reasons of easier intake, and colorants for better differentiation as well as antioxidants and/or vitamins and sweeteners such as sugar or artificial sweetening agents. This is also true for inspissated juices which are formulated with water before ingestion. Ion exchange resins in combination with one or more active ingredients are also to be mentioned for the production of liquid ingestable forms.

A special release form consists in the preparation of so-called floating medicinal forms, for example based on tablets or pellets which develop gas after contact with body fluids and therefore float on the surface of the gastric fluid. Furthermore, so-called electronically controlled release systems can also be formulated by which active ingredient release can be selectively adjusted to individual needs.

A further group of systemic administration and also optionally topically effective medicinal forms are represented by rectally applicable medicaments. Among these are suppositories and enema formulations. The enema formulations can be prepared based

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on tablets with aqueous solvents for producing this administration form. Rectal capsules can also be made available based on gelatin or other carriers.

Hardened fat, such as for example Witepsol®, Massa Estarinum®, Novata®, coconut fat, glycerol-gelatin masses, glycerol-soap-gels and polyethylene glycols are suitable as suppository bases.

For long-term application with a systematic active ingredient release up to several weeks, pressed implants are suitable which are preferably formulated on the basis of so-called biodegradable polymers.

As a further important group of systemically active medicaments, transdermal systems are also to be emphasized which distinguish themselves, as with the above-mentioned rectal forms, by circumventing the liver circulation system and/or liver metabolism. These plasters can be especially prepared as transdermal systems which are capable of releasing the active ingredient in a controlled manner over longer or shorter time periods based on different layers and/or mixtures of suitable adjuvants and carriers. Aside from suitable adjuvants and carriers such as solvents and polymeric components, for example based on Eudragit®, membrane infiltration increasing substances and/or permeation promoters, such as for example oleic acid, Azone®, adipinic acid derivatives, ethanol, urea, propylglycol are suitable in the production of transdermal systems of this type for the purpose of improved and/or accelerated penetration.

As topically, locally or regionally administration medicaments, the following are suitable as special formulations: vaginally or genitally applicable emulsions, creams, foam tablets, depot implants, ovular or transurethral administration installation solutions. For ophthalmological application, highly sterile eye ointments, solutions and/or drops or creams and emulsions are suitable.

In the same manner, corresponding otological drops, ointments or creams can be designated for application to the ear. For both of the above-mentioned applications, the administration of semi-solid formulations, such as for example gels based on Carbopol® or other polymer compounds such as for example polyvinylpyrrolidone and cellulose derivatives is also possible.

For customary application to the skin or also to the mucus membrane, normal emulsions, gels, ointments, creams or mixed phase and/or amphiphilic emulsion systems (oil/water-water/oil mixed phase) as well as liposomes and transfersomes can be named. Sodium alginate as a gel builder for production of a suitable foundation or cellulose derivatives, such as for example guar or xanthene gum, inorganic gel builders, such as for example aluminum hydroxides or bentonites (so-called thixotropic gel builder), polyacrylic acid derivatives, such as for example Carbopol®, polyvinylpyrrolidone, microcrystalline cellulose or carboxymethylcellulose are suitable as adjuvents and/or carriers. Furthermore, amphiphilic low and high molecular weight compounds as well as phospholipids are suitable. The gels can be present either as hydrogels based on water or as hydrophobic organogels, for example based on mixtures of low and high molecular paraffin hydrocarbons and vaseline.

Anionic, cationic or neutral tensides can be employed as emulsifiers, for example alkalized soaps, methyl soaps, amine soaps, sulfonated compounds, cationic soaps, high fatty alcohols, partial fatty acid esters of sorbitan and polyoxyethylene sorbitan, for example lanette types, wool wax, lanolin, or other synthetic products for the production of oil/water and/or water/oil emulsions.

Hydrophilic organogels can be formulated, for example, on the basis of high molecular polyethylene glycols. These gel-like forms are washable. Vaseline, natural or synthetic waxes, fatty acids, fatty alcohols, fatty acid esters, for example as mono-, di-, or triglycerides, paraffin oil or vegetable oils, hardened castor oil or coconut oil, pig fat, synthetic fats, for example based on acrylic, caprylic, lauric and stearic acid, such as

for example Softisan® or triglyceride mixtures such as Miglyol® are employed as lipids in the form of fat and/or oil and/or wax-like components for the production of ointments, creams or emulsions.

Osmotically effective acids and bases, such as for example hydrochloric acid, citric acid, sodium hydroxide solution, potassium hydroxide solution, monosodium carbonate, further buffer systems, such as for example citrate, phosphate, Tris-buffer or triethanolamine are used for adjusting the pH value.

Preservatives, for example such as methyl- or propyl benzoate (parabenes) or sorbic acid can be added for increasing stability.

Pastes, powders or solutions are to be mentioned as further topically applicable forms. Pastes often contain lipophilic and hydrophilic auxiliary agents with very high amounts of fatty matter as a consistency-giving base.

Powders or topically applicable powders can contain for example starch varieties such as wheat or rice starch, flame dispersed silicon dioxide or silica, which also serve as diluents, for increasing flowability as well as lubricity as well as for preventing agglomerates.

Nose drops or nose sprays serve as nasal application forms. In this connection, nebulizers or nose creams or ointments can come to use.

Furthermore, nose spray or dry powder formulations as well as controlled dosage aerosols are also suitable for systemic administration of the active ingredients.

These pressure and/or controlled dosage aerosols and dry powder formulations can be inhaled and/or insufflated. Administration forms of this type also certainly have importance for direct, regional application in the lung or bronchi and larynx. Thereby, the dry powder compositions can be formulated for example as active ingredient-soft

pellets, as an active ingredient-pellet mixture with suitable carriers, such as for example lactose and/or glucose. For inhalation or insufflation, common applicators are suitable which are suitable for the treatment of the nose, mouth and/or pharynx. The active ingredients can also be applied by means of an ultrasonic nebulizing device. As a propellant gas for aerosol spray formulations and/or controlled dosage aerosols, tetrafluoroethane or HFC 134a and /or heptafluoropropane or HFC 227 are suitable, wherein non-fluorinated hydrocarbons or other propellants which are gaseous at normal pressure and room temperature, such as for example propane, butane or dimethyl ether can be preferred. Instead of controlled dosage aerosols, propellant-free, manual pump systems can also be used.

The propellant gas aerosols can also suitably contain surface active adjuvents, such as for example isopropyl myristate, polyoxyethylene sorbitan fatty acid ester, sorbitan trioleate, lecithins or soya lecithin.

For regional application in situ, solutions for installation, for example for transurethral administration in bladder tumors or genital tumors, or for profusion in liver tumors or other organ carcinomas are suitable.

The respective suitable medicinal forms can be produced in accordance with the prescription and procedures based on pharmaceutical-physical fundamentals as they are described for example in the following handbooks and are included in the present inventive subject-matter with respect to the production of the respective suitable medicaments:

Physical Pharmacy (A.N. Martin, J. Swarbrick, A. Cammarata), 2nd Ed., Philadelphia Pennsylvania, (1970), German version: Physikalische Pharmazie, (1987), 3rd edition, Stuttgart;

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H. Sucker, P. Fuchs, P. Speiser, Pharmazeutische Technologie, Georg Thieme Verlag, Stuttgart - New York, (1991), 2nd edition;

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H. Asch, D. Essig, P.C. Schmidt, Technologie von Salben, Suspensionen und Emulsionen, Wissenschaftliche Verlagsgesellschaft mbH, Stuttgart, (1984);

H.A. Liebermann, L. Lachman, J.B. Schwartz, Pharmaceutical Desage forms: Tablets, Volume 1, Marcel Dekker Inc., New York, 2nd Edition (1989);

D. Chulin, M. Deleuil, Y. Pourcelot, Powder Technology and Pharmaceutical Processes, in J.C. Williams, T. Allen, Handbook of Powder Technology, Elsevier Amsterdam - London - New York - Tokyo, (1994);

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J.T. Carstensen, Pharmaceutical Principles of Solid Dosage Forms, Technomic Publishing Co., Inc., Lancaster - Basel, (1993).

PRODUCTION EXAMPLES

1. Injection therapeutics

a) Parenteral Solution

| | |
|---------------------------------------------------|----------------|
| active ingredient used according to the invention | 5.000 g |
| acid sodium phosphate | 5.000 g |
| sodium tartrate | 12.000 g |
| benzyl alcohol | 7.500 g |
| water for injection purposes | to 1000.000 ml |

The solution is produced according to the customary method, sterilized and filled into 10 ml vials. One vial contains 50 mg of the compound according to the invention.

b) Pentaler Solution

| | |
|---------------------------------------------------|----------------|
| active ingredient used according to the invention | 1.000 g |
| hydrochloric acid, dilute | 5.000 g |
| sodium chloride | 6.000 g |
| water for injection purposes | to 1000.000 ml |

The solution is produced according to a customary method by stirring; the medicinal form is adjusted to a suitable pH value by acid addition and subsequently filled into 100 ml vials and sterilized. A vial contains 100 mg of the compound according to the invention.

c) Parenteral Dispersion

| | |
|---------------------------------------------------|-----------|
| active ingredient used according to the invention | 10.000 g |
| soya lecithin | 20.000 g |
| saturated triglycerides | 100.000 g |

| | |
|------------------------------|----------------|
| sodium hydroxide | 7.650 g |
| water for injection purposes | to 1000.000 ml |

The active ingredient(s) used according to the invention is dispersed in the saturated triglycerides. Then the soya lecithin is added under stirring, and subsequent to this, the aqueous solution of sodium hydroxide is added with subsequent homogenization. The dispersion is sterilized and filled into 10 ml vials. A vial contains 50 mg of the compound according to the invention.

d) Biodegradable Parenteral Depot Medicinal Form

| | |
|---------------------------------------------------|----------------|
| active ingredient used according to the invention | 10.000 |
| polylactic acid /polyglycolic acid polymer | 70.000 |
| polyvinylpyrrolidone | 0.200 |
| gelatin | 2.000 |
| soya lecithin | 2.000 |
| isotonic sodium chloride solution | to 1000.000 ml |

First, the active ingredient is incorporated into the biodegradable polymer comprising polylactic acid and polyglycolic acid by a suitable method (spray drying, solvent-evaporation or phase separation) and subsequently subjected to a sterilization process. The particles are introduced into a 2-chamber ready-made syringe in which the adjuvant solution, which is also produced in a sterile manner, is filled. The biodegradable microparticles are mixed with the dispersion agent shortly before application and dispersed. A ready-made syringe contains 200 mg of the active compound according to the invention.

e) Parenteral Dispersion for Subcutaneous Installation

| | |
|---------------------------------------------------|----------|
| active ingredient used according to the invention | 25,000 g |
| soya lecithin | 25,000 g |

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| | |
|----------------|---------------|
| arachis oil | 400,000 g |
| benzyl alcohol | 50,000 g |
| Miglyole® | to 1000,000 g |

The active ingredient is dispersed together with soya lecithin and arachis oil. The benzyl alcohol is dissolved in Miglyole® and added to the dispersion. The entire dispersion is sterilized and subsequently filled into vials with 2 ml content. A vial contains 50 mg active ingredient.

f) Parenteral Perfusions Solution

The solution named under example b) can also be used for perfusion of liver for example.

According to need, instead of ampules with injection solution, so-called perforation bottles (vials), which can also be optionally preserved, and infusion solutions with an amount of one or more active ingredients according to the invention can also be made available in the customary manner under addition of buffer substances for adjustment of physiological pH value and/or the isotonicity and/or a best possible suitable pH value for the medicinal form (euhydria) and optional further required nutrients, vitamins, amino acids, stablizers and other necessary adjuvents, possibly in combination with further medicinal agents suitable for the mentioned indications.

2. Solid, Peroral Administration Medicaments

a) Tablets

| | |
|---------------------------------------------------|----------|
| active ingredient used according to the invention | 10,000 g |
| lactose | 5,200 g |
| starch, soluble | 1,800 g |

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| | |
|------------------------------|-------|
| hydroxypropylmethylcellulose | 900 g |
| magnesium stearate | 100 g |

The above components are mixed with each other and compacted in a conventional manner, wherein a tablet weight of 180 mg is set. Each tablet contains 100 mg active ingredient. If desired, the tablets obtained in this manner are coated, provided with a film coat and/or enterically coated.

b) Coated Tablet Core

| | |
|---------------------------------------------------|----------|
| active ingredient used according to the invention | 10,000 g |
| flame dispersed silicon dioxide | 500 g |
| corn starch | 2,250 g |
| stearic acid | 350 g |
| ethanol | 3.0 l |
| gelatin | 900 g |
| purified water | 10.0 l |
| talcum | 300 g |
| magnesium stearate | 180 g |

From these components, a granulate is produced which is pressed to the desired coated tablet cores. Each core contains 50 mg of active ingredient. The core can be further processed in a customary manner to coated tablets. If desired, a gastric fluid resistant or retarding film coat can be applied in a known manner.

c) Drink Suspension in Vials

| | |
|---------------------------------------------------|---------|
| active ingredient used according to the invention | 0.050 g |
| glycerin | 0.500 g |
| sorbitol, 70% solution | 0.500 g |
| sodium saccharinate | 0.010 g |

(44)

| | |
|--------------------------|--------------|
| methyl-p-hydroxybenzoate | 0.040 g |
| aromatic agent | q.s. |
| sterile wasser | q.s. to 5 ml |

The above-mentioned components are mixed in a customary manner to a suspension and filled in a suitable drink vial having 5 ml content.

d) Poorly Soluble Sublingual Tablets

| | |
|---------------------------------------------------|-----------------|
| active ingredient used according to the invention | 0.030 g |
| lactose | 0.100 g |
| stearic acid | 0.004 g |
| talcum purum | 0.015 g |
| sweetener | q.s. |
| aromatic agent | q.s. |
| rice starch | q.s. to 0.500 g |

The active ingredient is compacted together with the adjuvents under high pressure to sublingual tablets, favorably in oblong form.

e) Soft Gel Capsule

| | |
|---------------------------------------------------|-----------------|
| active ingredient used according to the invention | 0.050 g |
| fatty acid glyceride mixture (Miglyole®) | q.s. to 0.500 g |

The active ingredient is impasted together with the fluid carrier mixture and mixed together with further adjuvents suitable for the encapsulation and filled into elastic soft gelatin capsules which are sealed.

f) Hard Gelatin Capsules

| | |
|---------------------------------------------------|---------|
| active ingredient used according to the invention | 0.150 g |
| microcrystalline cellulose | 0.100 g |
| hydroxypropylmethylcellulose | 0.030 g |
| mannite | 0.100 g |
| ethylcellulose | 0.050 g |
| triethyl citrate | 0.010 g |

The active ingredient is mixed together with the adjuvants, microcrystalline cellulose, hydroxypropylmethylcellulose and mannite, wet with granulation liquid and formed into pellets. These are subsequently coated with a solution of ethylcellulose and triethyl citrate in organic solvents in a fluidized-bed apparatus. A hard gelatin capsule contains 150 mg of active ingredient.

3. Topically Administratable Medicinal Forms

a) Hydrophilic Ointment

| | |
|---------------------------------------------------|-------------------|
| active ingredient used according to the invention | 0.500 g |
| Eucerinum® anhydricum | 60.000 g |
| microcrystalline wax | 15.000 g |
| vaseline oil | q.s. to 100.000 g |

The above-mentioned adjuvants are melted and further processed together with the active ingredient to an ointment in a customary manner.

b) Lipophilic Ointment

| | |
|---------------------------------------------------|----------------|
| active ingredient used according to the invention | 10.000 g |
| propylene glycol | 50.000 g |
| paraffin, liquid | 100.000 g |
| paraffin wax | 100.000 g |
| vaseline | to 1000.000 ml |

The active ingredient(s) used according to the invention is dissolved in propylene glycol at ca. 60°C. At the same time, the lipophilic components are melted at 60-70°C and subsequently combined with the active ingredient solution. The ointment is emulsified at first at 60-70°C and subsequently cooled to 35-40°C under constant emulsification and then filled in 10 g tubes. A tube contains 100 mg of the compound according to the invention.

4. Inhalation Therapeutic

Further subject-matter is a pharmaceutical formulation which is characterized in that it contains an active ingredient(s) used according to the invention as a base or a physiologically acceptable salt thereof together with carriers and/or diluents customary for this and suitable for administration by means of inhalation.

In connection with the production of the medicaments, particularly suitable physiologically acceptable salts of the active ingredients are, as already illustrated in the synthesis section, acid addition salts derived from inorganic or organic acids such as for example especially hydrochloride, hydrobromide, sulfate, phosphate, maleate, tartrate, citrate, benzoate, 4-methoxybenzoate, 2- or 4-hydroxybenzoate, 4-chlorobenzoate, p-tosylate, methanesulfonate, ascorbate, salicylate, acetate, formate, succinate, lactate, glutarate, gluconate or tricarballylate.

The administration of the active ingredient(s) used of the invention by means of inhalation occurs according to the invention in conventional ways customary for administrations of this form, for example in the form of a commercial controlled dosage aerosol or in combination with a spacer. In controlled dosage aerosols, a metering valve is delivered with whose help, a dosed amount of the composition is administered. For spraying, the present compositions can be formulated for example as aqueous solutions or suspensions and be administered by means of an atomizer. Aerosol spray formulations in which the active ingredient is either suspended with one or two stabilizers in a propellant as a carrier and/or diluent, for example tetrafluoroethane or HFC 134a and/or heptafluoropropane or HFC 227 can equally be used, whereby however, non-fluorinated hydrocarbons or other propellants which are gaseous at normal pressure and room temperature, such as propane, butane or dimethyl ether, can be preferred. Thereby, propellant-free manual pump systems or dry powder systems as described below can also be used.

Suitably, the propellant aerosols can also contain surface active adjuvants, such as for example isopropyl myristate, polyoxyethylene sorbitan fatty acid ester, sorbitan trioleate, lecithins, oleic acid.

For administration by means of inhalation and/or insufflation, the medicaments with an amount of compounds according to the invention can also be formulated in the form of dry powder compositions, for example as active ingredient-soft pellets or as an active ingredient-powder mixture with a suitable carrier, such as for example lactose and/or glucose. The powder compositions can be formulated and administered as single doses or as multiple doses.

The compounds according to the invention are preferably administered by means of a controlled dosage aerosol or in the form of a dry powder dosage formulation, wherein the latter preferably contains glucose and/or lactose as a carrier substance.

As applicators for inhalation of the pharmaceutical formulations containing one or more of the active ingredient(s) used according to the invention, all applicators are generally suitable which are suitable for controlled dosage aerosols and/or a dry powder dosage formulation, such as for example usual applicators for the nose, mouth and/or pharynx, or also devices standing under propellant gas for the delivery of a spray (as controlled dosage aerosol or dry powder dosage formulation) as they are also used for inhalations in the nose, mouth and/or pharynx.

A further embodiment can also consist of an aqueous solution of the active ingredient(s) used according to the invention, which also optionally contains further active ingredients and/or additives, which are applied by means of an ultrasound atomizer.

a) Controlled Dosage Aerosol

| | Intended dose per stroke | per aerosol % by weight |
|------------------------------------------------------|-----------------------------|----------------------------|
| active ingredient used according to the invention | 0.500 mg | 0.66 |
| stabilizer | 0.075 mg | 0.10 |
| HFC 134a | 75.500 mg | 99.24 |

b) Controlled Dosage Aerosol

| | Intended dose per stroke | per aerosol % by weight |
|------------------------------------------------------|-----------------------------|----------------------------|
| active ingredient used according to the invention | 0.250 mg | 0.32 |
| Stabilizer | 0.038 mg | 0.05 |
| HFC 227 | 79.180 mg | 99.63 |

In the examples a) and b) the micronized active ingredient is, after previous dispersion in a small amount of the stabilizer, placed in a suspension vessel in which the bulk amount of propellant gas solution is found. The corresponding suspension is dispersed by means of a suitable stirring system (for example high performance mixer or ultrasound mixer) until an ultra-fine dispersion results. The suspension is then continuously held in flux in a filling apparatus suitable for cold propellants or pressure fillings. Alternatively, the suspension can also be produced in a suitable cooled stabilizer solution in HFC 134a/227.

The examples c) to d) describe the composition and production of dosage dry powder formulations.

c) Dosage-Dry Powder Formulation

mg/dose

active ingredient used according to the invention 0.500 mg

d) Dosage-Dry Powder Formulation

mg/dose

active ingredient used according to the invention 0.500 mg

lactose Ph.Eur. to 2.5 mg or
to 5.0 mg

e) Dosage-Dry Powder Formulation

mg/dose

| | |
|---------------------------------------------------|--------------|
| active ingredient used according to the invention | 0.250 mg |
| lactose Ph.Eur. | to 2.5 mg or |
| | to 5.0 mg |

In example c) the active ingredient is formulated after micronization under addition of steam as pellets with an MMAD between 0,1 and 0,3 mm diameter and brought to use in a multi-dose powder applicator.

In the examples d) and e) the active ingredient is micronized, thereafter, bulk material is mixed with the lactose in the given amounts, and subsequently, filled in a multi-dose powder inhalator.

In all of the examples set forth above, the active ingredient or the medicinal agent in the form of the respective suitable pharmaceutical acceptable salt and/or acid addition salts can be present, insofar as the base is not preferred in each case.

In the following, the pharmaceutical test results obtained in connection with the newly found indications based, in a representative manner, on the specifically structured new compounds are described.

PHARMACEUTICAL EXPERIMENTAL SECTION

1. Growth Inhibition of Human Tumor Cells

The tumor growth inhibiting activity of the substances was determined on human tumor cells in standardized in vitro test systems. In the screening tests, the substances gave IC₅₀-values in a concentration range of 0.1 nM to 10 µM.

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Example:

HepG2 cells plated at a density of 20,000 cells/ml in 12-well plastic dishes. Cultivation occurred in Richters IMEM-ZO nutrient medium with 5% fetal calf serum (FCS) in a tissue culture incubator with a gas mixture of 5% CO₂ and 95% air at a temperature of 37°C. One day after plating, the culture medium was aspirated from the cells and replaced by fresh medium which contained the respective concentrations of the test substances. For the individual concentrations and the controls without test substances, three-fold batches were done for each. Three days after the beginning of treatment, the medium was again renewed with the test compounds. After six days of substance incubation, the test was ended and the protein amount in the individual wells was determined with the sulforhodamin-B-method (according to P. Skehan et al.: New Colorimetric Cytotoxicity Assay for Anticancer-Drug Screening. J. Natl. Cancer Inst. 82: 1107-1112, 1990). The IC₅₀-values (defined as that concentration in which the cell growth was inhibited by 50%) was taken from the dose-response curves and given as a comparative measurement for the activity of the test compounds.

The following results were obtained:

| Test substance No. | IC ₅₀ -value [μM] |
|--------------------|------------------------------|
| 136 | 0.002 |
| 153 | 0.002 |
| 159 | 0.0005 |
| 178 | 0.0007 |
| 199 | 0.001 |

2. Indications

The compounds of formula (I) and their salts permit a therapeutic use in malignant illnesses of humans and animals through their excellent inhibition of the growth of tumor cells. The anti-neoplastic activity of the described substances can be used for

prophylactic, adjunct, palliative, and curative treatment of solid tumors, leukemic illnesses and lymphomas as well as for decreasing or preventing metastasis formation in humans and animals. The therapeutic use is possible in the following illnesses for example: gynecological tumors, such as of the uterus or the vagina, ovarian carcinomas, testicle tumors, prostate carcinomas, skin cancer, kidney cancer, bladder tumors, esophagus carcinomas, stomach cancer, rectal carcinomas, pancreas carcinomas, thyroid cancer, adrenal tumors, leukemia and lymphomas, Hodgkin's disease, tumor illnesses of the CNS, soft-tissue sarcomas, bone sarcomas, benign and malignant mesotheliomas, but especially intestine cancer, liver cancer, breast cancer, bronchial and lung carcinomas, melanomas, acute and chronic leukemias. Benign papillomatosis tumors are also considered for therapy with the named substances.

The novel structural class of compounds possesses an independent activity profile in the effectiveness against the various tumor types. Thus, tumors which are resistant to customary cytostatic agents, for example, can respond entirely to these substances. In addition, based on the independent characteristics, combinations of the new compounds with known chemo-therapeutically used pharmaceuticals or other methods of treatment are considered as long as their properties are complimented in a suitable manner. The integration of the presently used compounds with their specific structures in a therapy scheme is successful with one or more substances from the following classes for example: anti-metabolites (for example cytarabine, 5-fluorouracil, 6-mercaptopurine, methotrexate), alkylating agents (for example busulfan, carmustine, cisplatin, carboplatin, cyclophosphamide, dacarbazine, melphalan, thiotepa), DNA-intercalating substances and topoisomerase inhibitors (for example actinomycin D, daunorubicin, doxorubicin, mitomycin C, mitoxantrone, etoposide, teniposide, topotecan, irinotecan), spindle poisons (for example vincristine, navelbin, taxol, taxoter), hormonally active agents (for example tamoxifen, flutamide, formestan, goserelin) or other cytostatic agents with complex modes of action (for example L-asparaginase, bleomycin, hydroxyurea). Resistant tumor cells can be made sensitive again by interaction of the new compounds with a mechanism of resistance for

common cytostatic agents (for example P-glycoprotein, MRP, glutathione-S-transferase, metallothionein). A combination is also applicable with radiation therapy, hyperthermia or immunotherapy, for example.

3. Immuno Suppressing Activity

Many anti-tumor agents have not only a cytotoxic effect on tumor cells, but also on the blood cell system. This leads to a weakening of the immune defence, which can, in turn, be specifically employed to suppress the rejection reaction after an organ transplantation for example. Therefore, a use of the main compounds, optionally in combination with other compounds effective for these indications is suitable in diseases such as psoriasis or autoimmune diseases. In order to test the possibility for a therapeutic use in illnesses of this type, the substance activity was tested on freshly isolated lymphocytes as follows:

The spleen of a Swiss mouse served as a lymphocyte source. The lymphocyte population was isolated from the spleen cell suspension over a ficoll gradient and taken up in IMEM-ZO culture medium with 0,1% dextran 70,000 and 2% fetal calf serum. The cells were plated at a density of ca. 500,000 cells/well/ml in a 12-well plate, 1 ml doubly concentrated test substance solution was pipetted per well and this was subsequently incubated in a tissue culture incubator at 37°C and 5% CO₂. After 2 days, a 1 ml-aliquot with 5 µl of the fluorescent dye solutions propidium iodide (8 mg/ml) and 3,3'-dihexyloxacarbocyanin iodide (40 µg/ml) each was added per well, and incubated for 3 minutes at room temperature. Subsequently, 10,000 cells per each sample were measured on a flow-through cytometer and the percentage amount of vital cells in the population was determined. By means of the dose-response curves, IC₅₀-values were calculated which were also employed in the following Tables for the characterization of the individual substances:

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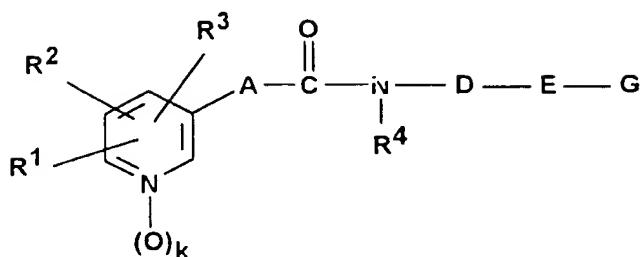
| Test Substance No. | IC ₅₀ [μM] |
|-----------------------|-----------------------|
| 150 | 0.0002 |
| 153 | 0.00008 |
| 159 | 0.003 |
| 195 | 0.002 |
| 199 | 0.00004 |

The independent class of the compounds used according to the invention also permits an efficient combination with known immunosuppressive agents such as for example cyclosporin A, tacrolimus, rapamycin, azathioprin and glucocorticoids.

The invention is in no way limited to the present respective concretely named active ingredient concentrations, dosages, combinations with one or more other cytostatic agents, tumor inhibitors, cancerostatic agents, immunosuppressive agents or further medicinal agents suitable for the respective specific indications or the type of tumor to treated or immunological illness, etc.

Claims

1. Compounds of formula (I)



wherein

R¹ hydrogen, halogen, cyano, trifluoromethyl, hydroxy, benzyloxy, aminocarbonyl, carboxy, phenyl, phenoxy, phenylthio, pyridyloxy, pyridylthio, alkyl, especially C₁-C₆-alkyl, alkenyl, especially C₃-C₆-alkenyl, alkinyl, especially C₃-C₆-alkinyl, hydroxyalkyl, especially C₁-C₆-hydroxyalkyl, alkoxy, especially C₁-C₆-alkoxy, alkenyloxy, especially C₃-C₆-alkenyloxy, alkinyloxy, especially C₃-C₆-alkinyloxy, alkanoyloxy, especially C₁-C₇-alkanoyloxy, alkoxycarbonyloxy, especially C₂-C₇-alkoxycarbonyloxy, alkylthio, especially C₁-C₆-alkylthio, alkenylthio, especially C₃-C₆-alkenylthio, alkinyllthio, especially C₃-C₆-alkinylthio, cycloalkyl, especially C₃-C₈-cycloalkyl,

cycloalkyloxy, especially C₃-C₈-cycloalkyloxy,
cycloalkylthio, especially C₃-C₈-cycloalkylthio,
alkoxycarbonyl, especially C₂-C₇-alkoxycarbonyl,
alkylaminocarbonyl, especially C₂-C₇-alkylaminocarbonyl,
dialkylaminocarbonyl, especially C₃-C₁₃-dialkylaminocarbonyl, or
NR⁵R⁶, wherein

R⁵ and

R⁶ are selected independently of each other from hydrogen,
alkyl, especially C₁-C₆-alkyl,
alkenyl, especially C₃-C₆-alkenyl and
alkinyl, especially C₃-C₆-alkinyl,

R² is hydrogen, halogen, cyano, hydroxy, trifluoromethyl, benzyloxy,
alkyl, especially C₁-C₆-alkyl,
alkoxy, especially C₁-C₆-alkoxy or
alkanoyloxy, especially C₁-C₇-alkanoyloxy,

wherein R¹ and R², if they are adjacent, optionally form a bridge which is
selected from

-(CH₂)₄-, -(CH=CH)₂- and -CH₂O-CR⁷R⁸-O-, wherein

R⁷ and

R⁸ are, independently of each other, hydrogen or alkyl, especially C₁-C₆-alkyl,

R³ is hydrogen, halogen, alkyl, especially C₁-C₆-alkyl, trifluoromethyl or
hydroxyalkyl, especially C₁-C₆-hydroxyalkyl and

R⁴ is hydrogen, hydroxy, benzyloxy,
alkyl, especially C₁-C₆-alkyl,
alkenyl, especially C₃-C₆-alkenyl,
alkinyl, especially C₃-C₆-alkinyl,
cycloalkyl, especially C₃-C₆-cycloalkyl or
alkoxy, especially C₁-C₆-alkoxy,

k is 0 or 1,

A is alkenylene with at least than two C-atoms, especially C₂-C₆- alkenylene,
which is optionally substituted once to three-fold by C₁-C₃-alkyl, hydroxy, C₁-
C₃-alkoxy, fluorine, cyano or phenyl,

alkadienylene with at least four C-atoms, especially C₄-C₆- alkadienylene,
which is optionally substituted once or twice by C₁-C₃-alkyl, fluorine, cyano or
phenyl,

1,3,5-hexatrienylene, which is optionally substituted by C₁-C₃-alkyl, fluorine,
cyano, or phenyl,

ethinylene

D is selected from alkylene, especially C₁-C₁₀-alkylene, optionally substituted
once or twice by alkyl, especially C₁-C₆-alkyl, hydroxy, or alkoxy, especially
C₁-C₆-alkoxy,

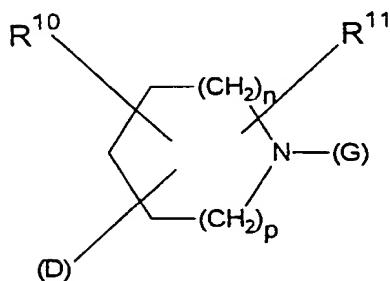
alkenylene with at least two C-atoms, especially C₂-C₁₀-alkenylene, which is optionally substituted once or twice by alkyl, especially C₁-C₆-alkyl, hydroxy, or alkoxy, especially C₁-C₆-alcoxy, wherein the double bond can also be to ring E,

alkinylene with at least three C-atoms, especially C₃-C₁₀-alkinylene, optionally substituted once or twice by alkyl, especially C₁-C₆-alkyl, hydroxy or alkoxy, especially C₁-C₆-alcoxy, and

alkylene, especially C₁-C₁₀-alkylene, alkenylene with at least two C-atoms, especially C₂-C₁₀-alkenylene or alkinylene with at least three C-atoms, especially C₃-C₁₀-alkinylene, whereby one to three methylene units are each isosterically replaced by O, S, NR⁹, CO, SO or SO₂ wherein

R⁹ is selected from hydrogen, alkyl, especially C₁-C₆-alkyl, alkenyl, especially C₃-C₆-alkenyl, alkinyl, especially C₃-C₆-alkinyl, acyl, especially C₁-C₆-acyl or alkylsulfonyl, especially C₁-C₆-alkylsulfonyl, has the same meaning as

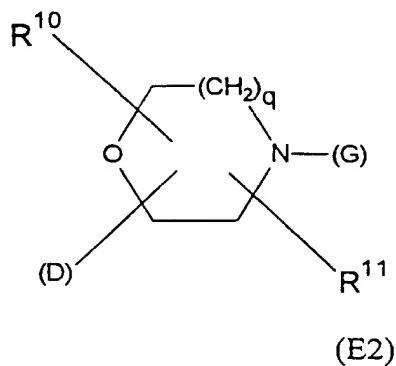
E is selected from



(E1)

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or



wherein the heterocyclic ring can also optionally have a double bond and

n and

p can be, independently of one another 0, 1, 2 or 3, with the proviso that **n + p ≤ 4**
and

q is 2 or 3,

R¹⁰ is hydrogen, alkyl, especially C₁-C₆-alkyl, hydroxy, hydroxymethyl, carboxy or alkoxy carbonyl with at least two C-atoms, especially C₂-C₇-alkoxy carbonyl and

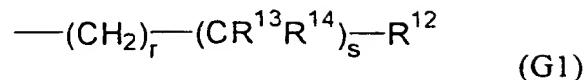
R¹¹ is hydrogen, alkyl, especially C₁-C₆-alkyl or an oxo group adjacent to the nitrogen atom, wherein

R¹⁰ and **R¹¹** optionally together, form an alkylene bridge with 1, 2, 3, 4 or 5 C-atoms, especially a C₁-C₃-alkylene bridge under formation of a bicyclic ring system,

G is selected from **hydrogen**,

G1, G2, G3, G4 and G5, wherein

G1 represents the residue



wherein

r is an integer from 1 to 3 or 0 and

s is 0 or 1,

R¹² is selected from hydrogen, alkyl, especially C₁-C₆-alkyl, alkenyl with at least three C-atoms, especially C₃-C₆-alkenyl, alkinyl with at least three C-atoms, especially C₃-C₆-alkinyl, cycloalkyl with at least three C-atoms, especially C₃-C₈-cycloalkyl,

saturated, five to seven membered heterocycles, which can contain one or two hetero-atoms from the group N and/or S and/or O,

benzyl or phenyl,

monocyclic aromatic five or six-membered heterocycles, which can contain one to three hetero-atoms from the group N and/or S and/or O and are either bound directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein the linkage can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein one to three ring atoms can be selected from N and/or S and/or O and the linkage can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

R¹³ has the same meaning as **R¹²**, but is selected independently thereof,

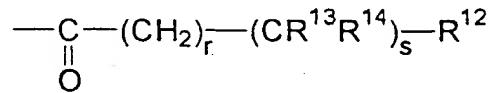
R¹⁴ is selected from hydrogen, hydroxy, methyl, benzyl, phenyl,

monocyclic aromatic five- or six-membered heterocycles, which can contain one to three hetero-atoms selected from the group N and/or S and/or O and are either bound directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein the linkage can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

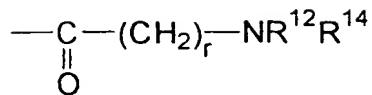
anellated bi- and tricyclic aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein one to three ring atoms can be selected from N and/or S and/or O and the linkage can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

G2 is the residue



(G2a)

or



(G2b)

wherein the substituents R^{12} and R^{14} can have the above meaning or the grouping

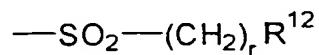


can also be a nitrogen heterocycle bound over the nitrogen atom, selected from

saturated or unsaturated monocyclic, four- to eight-membered heterocycles, which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from the group N and/or S and/or O, or

saturated or unsaturated bi- or tricyclic, anellated or bridged heterocycles with 8 to 16 ring atoms, which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from the group N and/or S and/or O,

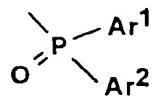
G3 is the residue



(G3)

and

G4 is the residue



(G4)

wherein

Ar¹ and **Ar²** are selected independently from one another from phenyl, pyridyl or naphthyl and

G5 is the residue



(G5)

wherein

R¹⁵ is selected from trifluoromethyl, alkoxy, especially C₁-C₆-alkoxy, alkenyloxy, especially C₃-C₆-alkenyloxy, or benzyloxy,

wherein any aryl residues and/or aromatic ring systems in the substituents **R¹, R², R⁴, R¹², R¹³, R¹⁴, R¹⁵, Ar¹ and Ar²** and/or in the ring system -NR¹²R¹⁴ can be substituted independently from each other by one to three of the same or different residues which are selected from halogen, cyano, alkyl, especially C₁-C₆-alkyl, trifluoromethyl, cycloalkyl, especially C₃-C₈-cycloalkyl, phenyl, benzyl, hydroxy, alkoxy, especially C₁-C₆-alkoxy, alkoxy, substituted entirely or partially by fluorine, substituted alkoxy especially C₁-C₆-alkoxy, benzyloxy, phenoxy, mercapto, alkylthio, especially C₁-C₆-alkylthio, carboxy, alkoxycarbonyl, especially C₁-C₆-aloxycarbonyl, benzyloxycarbonyl, nitro, amino, monoalkylamino, especially mono-C₁-C₆-alkylamino, dialkylamino, especially di-(C₁-C₆-alkyl)-amino and methylenedioxy for two adjacent groups on the aromatic ring or ring system,

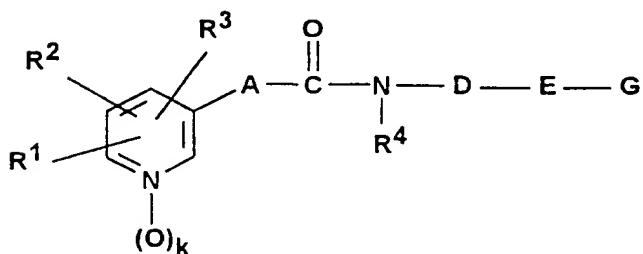
wherein each of the residues alkyl, alkenyl, alkinyl, hydroxyalkyl, alkoxy, alkenyloxy, alkinyloxy, alkanoyloxy, alkoxycarbonyl, alkoxycarbonyloxy, alkylthio, alkenylthio, alkinylthio, alkylene, acyl, alkylsulfonyl, alkenylene, alkinylene, cycloalkyl, cycloalkyloxy, alkoxycarbonyl, alkylaminocarbonyl or dialkylaminocarbonyl of the substituents R^1 to R^{13} can have 1 to 2 or 4, 6, 8, 10 or 12 C-atoms and/or 2 or 3 to 5, 7, 9, 11 or 13 and/or 15 C-atoms or 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 or 15 C-atoms depending on the structure, as well as

stereoisomers and/or mixtures thereof and pharmacologically acceptable

acid addition salts

with the exception of (E)-3-(3-piridyl)-N-[2-(1-benzylpiperidin-4-yl)ethyl]-2-propenamide hydrochloride.

2. Compound of formula (I)



wherein

R^1 is a hydrogen, halogen, cyano, $\text{C}_1\text{-}\text{C}_6$ -alkyl, $\text{C}_3\text{-}\text{C}_6$ -alkenyl, $\text{C}_3\text{-}\text{C}_6$ -alkinyl, trifluoromethyl, $\text{C}_3\text{-}\text{C}_8$ -cycloalkyl, $\text{C}_1\text{-}\text{C}_6$ -hydroxyalkyl, hydroxy, $\text{C}_1\text{-}\text{C}_6$ -alkoxy, $\text{C}_3\text{-}\text{C}_6$ -alkenyloxy, $\text{C}_3\text{-}\text{C}_6$ -alkinyloxy, benzyloxy, $\text{C}_1\text{-}\text{C}_7$ -alkanoyloxy,

C₂-C₇-alkoxycarbonyloxy, C₁-C₆-alkylthio, C₃-C₆-alkenylthio, C₃-C₆-alkinylthio, C₃-C₈-cycloalkyloxy, C₃-C₈-cycloalkylthio, C₂-C₇-alkoxycarbonyl, aminocarbonyl, C₂-C₇-alkylaminocarbonyl, C₃-C₁₃-dialkylaminocarbonyl, carboxy, phenyl, phenoxy, phenylthio, pyridyloxy, pyridylthio, or NR⁵R⁶, wherein

R⁵ and

R⁶ are selected independently from each other from hydrogen, C₁-C₆-alkyl, C₃-C₆-alkenyl and C₃-C₆-alkinyl,

R² is hydrogen, halogen, cyano, C₁-C₆-alkyl, trifluoromethyl, hydroxy, C₁-C₆-alkoxy, benzyloxy or C₁-C₇-alkanoyloxy,

wherein R¹ and R², in case they are adjacent, optionally form a bridge which is selected from the bridge members

-(CH₂)₄- and -(CH=CH)₂- and -CH₂O-CR⁷R⁸-O-, wherein

R⁷ and

R⁸ are, independently from each other, hydrogen or C₁-C₆-alkyl,

R³ is hydrogen, halogen, C₁-C₆-alkyl, trifluoromethyl or C₁-C₆-hydroxyalkyl and

R⁴ is hydrogen, C₁-C₆-alkyl, C₃-C₆-alkenyl, C₃-C₆-alkinyl, C₃-C₆-cycloalkyl, hydroxy, C₁-C₆-alkoxy or benzyloxy,

k is 0 or 1,

A is C₂-C₆-alkenylene, which is optionally substituted once to three-fold by C₁-C₃-alkyl, hydroxy, C₁-C₃-alkoxy, fluorine, cyano or phenyl,

C₄-C₆-alkadienylene, which is optionally substituted once or twice by C₁-C₃-alkyl, fluorine, cyano or phenyl

1,3,5-hexatrienylene, which is optionally substituted by C₁-C₃-alkyl, fluorine, cyano or phenyl

ethinylene

)

D is selected from C₁-C₁₀-alkylene, optionally substituted once or twice by C₁-C₆-alkyl, hydroxy, or C₁-C₆-alkoxy,

C₂-C₁₀-alkenylene, which is optionally substituted once or twice by C₁-C₆-alkyl, hydroxy, or C₁-C₆-alkoxy, wherein the double bond can also be to ring E,

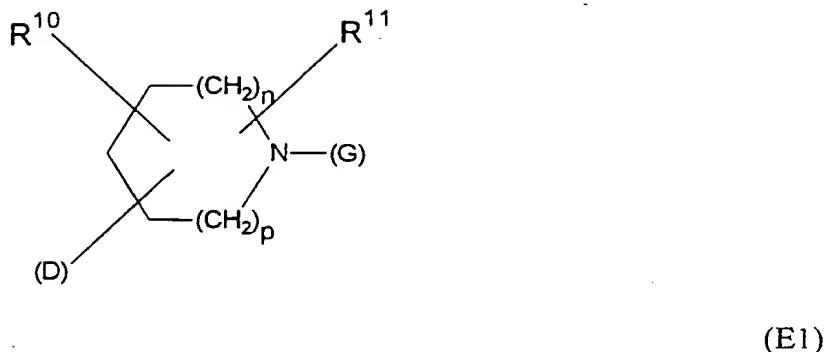
C₃-C₁₀-alkinylene, optionally substituted once or twice by C₁-C₆-alkyl, hydroxy, or C₁-C₆-alkoxy, and

)

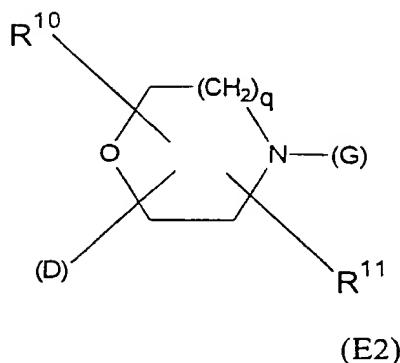
C₁-C₁₀-alkylene, C₂-C₁₀-alkenylene or C₃-C₁₀-alkinylene, wherein one to three methylene units are each isosterically replaced by O, S, NR⁹, CO, SO or SO₂, wherein

R⁹ is selected from hydrogen, C₁-C₆-alkyl, C₃-C₆-alkenyl, C₃-C₆-alkinyl, C₁-C₆-acyl or C₁-C₆-alkylsulfonyl,

E is selected from



or



wherein the heterocyclic ring can optionally have a double bond and

n and

p can be, independently of each other, 0, 1, 2 or 3, with the proviso that $n + p \leq 4$
and

q is 2 or 3,

R¹⁰ is hydrogen, C₁-C₆-alkyl, hydroxy, hydroxymethyl, carboxy or C₂-C₇-alkoxycarbonyl and

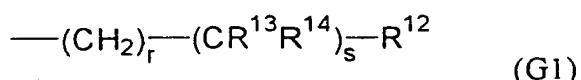
R¹¹ hydrogen, C₁-C₆-alkyl or an oxo group adjacent to the nitrogen atom, wherein

R¹⁰ and **R¹¹** optionally together form a C₁-C₃-alkylene bridge under formation of a bi-cyclic ring system,

G is selected from hydrogen,

G1, **G2**, **G3**, **G4** and **G5**, wherein

G1 represents the residue



wherein

r is an integer from 1 to 3 or 0 and

s is 0 or 1,

R¹² is selected from hydrogen, C₁-C₆-alkyl, C₃-C₆-alkenyl, C₃-C₆-alkinyl, C₃-C₈-cycloalkyl,

saturated, five- to seven-membered heterocycles, which can contain one or two hetero-atoms from the group N and/or S and/or O,

benzyl or phenyl,

monocyclic aromatic five or six-membered heterocycles, which can contain one to three hetero-atoms from the group N and/or S and/or O and are either bound directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein the linkage can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein one to three ring atoms can be selected from N and/or S and/or O and the linkage can occur either over an aromatic ring or a hydrated ring and either directly or over a methylene group,

R¹³ has the same meaning as **R¹²**, but is selected independently thereof,

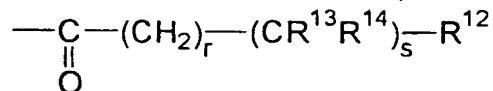
R¹⁴ is selected from hydrogen, hydroxy, methyl, benzyl, phenyl,

monocyclic aromatic five- or six-membered heterocycles, which can contain one to three hetero-atoms selected from the group N and/or S and/or O and are either bound directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein the linkage can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

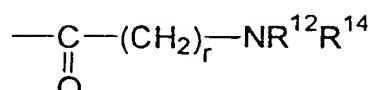
anellated bi- and tricyclic aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein one to three ring atoms can be selected from N and/or S and/or O and the linkage can occur either over an aromatic ring or a hydrated ring and either directly or over a methylene group,

G2 is the residue



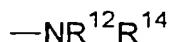
(G2a)

or



(G2b)

wherein the substituents R¹² and R¹⁴ can have the above meaning or the grouping

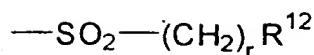


can also be a nitrogen heterocycle bound over the nitrogen atom, selected from

saturated or unsaturated monocyclic, four- to eight-membered heterocycles, which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from the group N and/or S and/or O, or

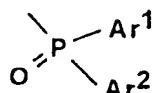
saturated or unsaturated bi- or tricyclic, anellated or bridged heterocycles with 8 to 16 ring atoms, which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from the group N and/or S and/or O,

G3 is the residue



(G3)

and

G4 is the residue

(G4)

wherein

Ar¹ and **Ar²** are selected independently from one another from phenyl, pyridyl or naphthyl and

G5 is the residue

(G5)

wherein

R¹⁵ is selected from trifluoromethyl, C₁-C₆-alkoxy, C₃-C₆-alkenyloxy, or benzyloxy, and wherein

aromatic ring systems in the substituents **R¹**, **R²**, **R⁴**, **R¹²**, **R¹³**, **R¹⁴**, **R¹⁵**, **Ar¹** and **Ar²** and/or in the ring system -NR¹²R¹⁴ can be substituted independently from each other by one to three of the same or different residues which are selected from halogen, cyano, C₁-C₆-alkyl, trifluoromethyl, C₃-C₈-Cycloalkyl, phenyl, benzyl, hydroxy, C₁-C₆-alkoxy, which can optionally be entirely or partially substituted by fluorine, benzyloxy, phenoxy, mercapto, C₁-C₆-alkylthio, carboxy, C₁-C₆-alkoxycarbonyl,

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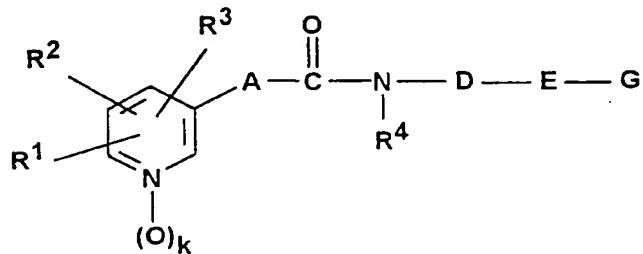
benzyloxycarbonyl, nitro, amino, mono-C₁-C₆-alkylamino or di-(C₁-C₆-alkyl)-amino and methylenedioxy for two adjacent groups on the aromatic ring or ring system,

their stereoisomers thereof and/or their mixtures thereof and pharmacologically acceptable

acid addition salts

with the exception of (E)-3-(3-piridyl)-N-[2-(1-benzylpiperidin-4-yl)ethyl]-2-propenamide hydrochloride .

3. Compounds according to claim 1 or 2, characterized in that the substituents R¹, R², R³, R⁴, R⁵, R⁶, R⁷, R⁸, R⁹, R¹², R¹³, R¹⁴ and R¹⁵ as well as A and D indicated therein have the following meaning in connection with the given substitutions according to formula (I)



wherein

halogen is fluorine, chlorine, bromine or iodine,

C₁-C₆-alkyl can be straight chain or branched and is preferably a methyl-, ethyl-, propyl-, isopropyl-, butyl-, isobutyl-, sec-butyl-, tert-butyl-, cyclopropylmethyl-, pentyl-,

isopentyl-, tert-pentyl-, neopentyl-, cyclopropylethyl-, cyclobutylmethyl- or a hexyl group,

alkylene is for example methylene, ethylene, propylene, tetramethylene, pentamethylene, hexamethylene, heptamethylene, octamethylene, nonamethylene or decamethylene,

C₃-C₆-alkenyl is straight chain or branched and is preferably an allyl-, 2-butenyl-, 3-butenyl-, 2-methyl-2-propenyl-, 2-pentenyl-, 4-pentenyl-, 2-methyl-2-butenyl-, 3-methyl-2-butenyl-, 2-hexenyl-, 5-hexenyl-, 4-methyl-3-pentenyl- or 2,2-dimethyl-3-butenyl group,

alkenylene is for example ethenylene, propenylene, butenylene, pentenylene, hexenylene, hexathenylene, heptenylene, octenylene, nonenylene or decenylene,

C₃-C₆-alkinyl is straight chain or branched and is preferably a propargyl-, 2-butinyl-, 3-butinyl-, 4-pentinyl-, 5-hexinyl- or 4-methyl-2-pentinyl group,

alkinylene is for example propinylene, butinylene, pentinylene, hexinylene, heptinylene, octinylene, noninylene or decinylene,

C₃-C₈-cycloalkyl is preferably cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl or cyclooctyl,

C₁-C₆-hydroxyalkyl contains a hydroxyl group in one of the above-named C₁-C₆-alkyl residues, especially in the form of the hydroxymethyl- and hydroxyethyl group, wherein

C₁-C₆-alkoxy, **C₃-C₆-alkenyloxy**, **C₃-C₆-alkinyloxy** each contain, aside from the oxygen atom, one of the C₁-C₆-alkyl-, C₃-C₆-alkenyl- and/or C₃-C₆-alkinyl groups

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named above and the methoxy-, ethoxy-, isopropoxy-, tert-butoxy-, allyloxy- and propargyloxy group are preferred and is to be understood as among C₁-C₆-alkoxy entirely or partially substituted with fluorine, for example difluormethoxy, trifluormethoxy or 2,2,2-trifluorethoxy,

C₁-C₆-alkylthio, C₃-C₆-alkenylthio, C₃-C₆-alkinylthio each contain, aside from the sulfur atom, one of the C₁-C₆-alkyl-, C₃-C₆-alkenyl- or C₃-C₆-alkinyl group named above, especially the methylthio-, ethylthio-, isopropylthio- and tert-butylthio group,

C₃-C₈-cycloalkyloxy and **C₃-C₈-cycloalkylthio** are preferred as cyclopentyloxy- and cyclopentylthio- and/or cylohexyloxy- and cyclohexylthio groups,

C₁-C₇-alcanoxyloxy groups contain, aside from the oxygen atom, an aliphatic acyl residue with 1 to 7 carbon atoms, especially the acetoxy-, propionyloxy- and pivaloyloxy group,

C₂-C₇-alkoxycarbonyl groups contain, aside from the carbonyl group, one of the C₁-C₆-alkoxy groups mentioned above, especially the methoxycarbonyl-, ethoxycarbonyl-, isopropoxycarbonyl-, isobutoxycarbonyl-and tert-butoxycarbonyl group,

C₂-C₇-alkoxycarbonyloxy groups contain, aside from the oxygen atom, one of the C₂-C₇-alkoxycarbonyl residues mentioned above, especially the methoxycarbonyloxy-, ethoxycarbonyloxy-, isopropoxycarbonyloxy-, isobutoxycarbonyloxy-and tert-butoxycarbonyl group as well as the allyloxycarbonyloxy group,

C₂-C₇-alkylaminocarbonyl and **C₃-C₁₃-dialkylaminocarbonyl groups** contain, beside the carbonyl group, an alkylamino- and/or dialkylamino residue, whose C₁-C₆-alkyl groups have the above meanings, wherein the dimethylaminocarbonyl-, diethylaminocarbonyl- and the diisopropylaminocarbonyl groups are preferred, and

one of the following C₁-C₆-alkylamino groups and/or di-(C₁-C₆-alkyl)amino groups are to be understood under the amino groups of the formula NR⁵R⁶, aside from the unsubstituted amino group,

C₁-C₆-alkylamino contains one of the C₁-C₆-alkyl groups mentioned above, especially in form of the methylamino-, ethylamino-, propylamino-, isopropylamino-, butylamino- and the tert-butylamino group,

di-(C₁-C₆-alkyl)amino carries two of the same or different of the above named C₁-C₆-alkyl groups on the nitrogen atom, especially in form of the dimethylamino-, diethylamino-, dipropylamino-, diisopropylamino-, isopropylmethylamino-, dibutylamino- or tert-butylmethylamino group,

C₁-C₆-acyl is the residue of an aliphatic saturated or unsaturated, straight chain, branched or cyclic carboxylic acid, especially in form of the formyl-, acetyl-, propionyl-, acryloyl-, butyryl-, isobutyryl-, methacryloyl-, cyclopropylcarbonyl-, pentanoyl-, pivaloyl-, cyclobutylcarbonyl-, hexanoyl- and the dimethylacryloyl group,

C₁-C₆-alkansulfonyl is preferably the methanesulfonyl-, ethanesulfonyl-, propanesulfonyl-, butanesulfonyl-, pentanesulfonyl- and the hexanesulfonyl group,

saturated five- to seven-membered heterocycles with one or two hetero-atoms are especially tetrahydrofuryl, tetrahydrothienyl, pyrrolidinyl, tetrahydropyranyl, Piperidinyl, hexahydroazepinyl, piperazinyl, hexahydrodiazepinyl or morpholinyl,

monocyclic aromatic five- or six-membered heterocycles with one to three hetero-atoms are especially furyl, thienyl, pyrrolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, imidazolyl, pyrazolyl, oxadiazolyl, thiadiazolyl, triazolyl, pyridyl, pyrazinyl, pyridazinyl, pyrimidinyl or triazinyl,

anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring are preferably benzocyclobutyl, indanyl, indenyl, naphthyl, dihydronaphthyl, tetrahydronaphthyl, biphenylenyl, fluorenyl, anthryl, dihydroanthryl, phenanthryl, dihydronaphthyl, dibenzocycloheptenyl, dihydrodibenzocycloheptenyl, dihydrodibenzocyclooctenyl or tetrahydrodibenzocyclooctenyl, wherein their mono- or dioxo-derivates, for example, the residues of indanone, tetralone, anthrone, anthraquinone, fluorenone, phenanthrone, dibenzocycloheptenone, dihydrodibenzocycloheptenone or tetrahydrodibenzocyclooctenone are also to be understood as partially hydrated carboxylic ring systems,

anellated bi- and tricyclische aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring are among, for example, imidazothiazolyl, benzofuryl, dihydrobenzofuryl, benzothienyl, dihydrobenzothienyl, indolyl, indolinyl, benzimidazolyl, indazolyl, benzoxazolyl, benzisoxazolyl, benzothiazolyl, benzoisothiazolyl, benzofurazanyl, benzothiadiazolyl, benzotriazolyl, oxazolopyridyl, thiazolopyridyl, isothiazolopyridyl, imidazopyridyl, pyrazolopyridyl, thienopyrimidinyl, chromanyl, benzopyranyl, quinolyl, isoquinolyl, dihydroquinolyl, tetrahydroquinolyl, benzodioxanyl, quinoxaliny, quinazolinyl, naphthyridinyl, carbazolyl, tetrahydrocarbazolyl, pyridoindolyl, acridinyl, phenothiazinyl, dihydrodibenzoxepinyl, benzocycloheptathienyl, dihydrothienobenzothiepinyl, dihydrodibenzothiepinyl, octahydrodibenzothiepinyl, dihydrodibenzazepinyl, octahydrodibenzazepinyl, benzocycloheptapyridyl, dihydropyridobenzodiazepinyl, dihydrodibenzoxazepinyl, dihydropyridobenzoxepinyl, dihydropyridobenzoxazepinyl, dihydrodibenzothiazepinyl or dihydropyridobenzothiazepinyl, wherein their mono- or dioxo-derivates and/or optionally their possible tautomeres are also to be understood as partially hydrated heterocyclic ring systems, for example, the residues of indolinone, isatin, benzoxazolone and/or their tautomeres hydroxybenzoxazol, of benzisoxazolone, benzothiazolone, benzoisothiazolone and benzimidazolone and/or their tautomeres, hydroxybenzisoxazol, hydroxybenzothiazol, hydroxybenzoisothiazol and

hydroxybenzimidazol, of indazolinone, of oxazolopyridinone, thiazolopyridinones, pyrazolopyridinones and imidazopyridinones and/or their tautomeres hydroxyoxazolopyridine, hydroxythiazolopyridines, hydroxypyrazolopyridines and hydroxyimidazopyridines, the residues of chromanone, chromone, quinolinone, dihydroquinolinone, tetrahydrocarbazolone, acridone, of dihydronaphthalenepinones, benzocycloheptathiophenones, dihydrothienobenzothiepinones, dihydronaphthalenthiepinones, dihydronaphthoazepinones, benzocycloheptapyridinones, dihydropyrido-benzoxazepinones, dihydronaphthothiazepinones and of dihydropyridobenzothiazepinones,

saturated and unsaturated monocyclic, four- to eight-membered heterocycles are

$-\text{NR}^{12}\text{R}^{14}$ as a grouping which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from N and/or S and/or O, for example azetidine, pyrrolidine, piperidine, (1H)tetrahydropyridine, hexahydroazepine, (1H)tetrahydroazepine, octahydroazocine, pyrazolidine, piperazine, hexahydrodiazepine, morpholine, hexahydrooxazepine, thiomorpholine or thiomorpholine-1,1-dioxide,

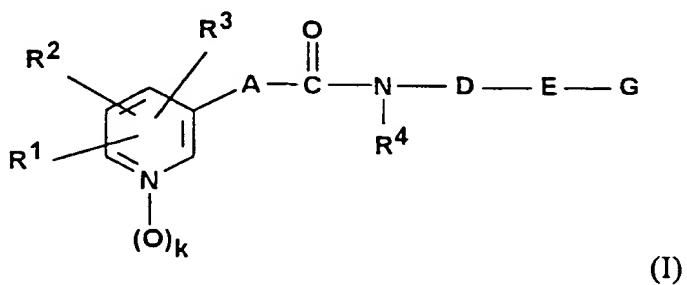
saturated or unsaturated bi- or tricyclic, anellated or bridged heterocycles with 8 to 16 ring atoms, represent $-\text{NR}^{12}\text{R}^{14}$ as a grouping which, aside from the essential nitrogen atom can optionally contain one or two further hetero-atoms, selected from N and/or S and/or O, for example 5-aza-bicyclo[2.1.1]hexane, 2-aza-bicyclo[2.2.1]heptane, 7-aza-bicyclo[2.2.1]heptane, 2,5-diaza-bicyclo[2.2.1]heptane, 2-aza-bicyclo[2.2.2]octane, 8-aza-bicyclo[3.2.1]octane, 2,5-diaza-bicyclo[2.2.2]octane, 9-aza-bicyclo[3.3.1]nonane, indoline, isoindoline, (1H)-dihydroquinoline, (1H)-tetrahydroquinoline, (2H)-tetrahydroisoquinoline, (1H)-tetrahydroquinoxaline, (4H)-dihydrobenzoxazine, (4H)-dihydrobenothiazine, (1H)-tetrahydrobenzo[b]azepine, (1H)-tetrahydrobenzo[c]azepine, (1H)-tetrahydrobenzo[d]azepine, (5H)-tetrahydrobenzo[b]oxazepine, (5H)-tetrahydrobenzo[b]thiazepine, 1,2,3,4-tetrahydro-9H-pyrido[3,4-

b]indol, (10H)-dihydroacridine, 1,2,3,4-tetrahydroacridanone, (10H)-phenoxazine, (10H)-phenothiazine, (5H)-dibenzazepine, (5H)-dihydrodibenzazepine, (5H)-octahydrodibenzazepine, (5H)-dihydrodibenzodiazepine, (11H)-dihydrodibenzo[b,e]oxazepine, (11H)-dihydrodibenzo[b,e]thiazepine, (10H)-dihydron-dibenzo[b,f]oxazepine, (10H)-dihydron-dibenzo[b,f]thiazepine or (5H)-tetrahydron-dibenzoazocine, as well as optionally typical

tautomeres in the case of substitution of the heterocycle as such or in an anellated ring system by free hydroxy-, mercapto- and/or amino groups, and

stereoisomers such as, if applicable, cis/trans-isomers, endo/exo-isomers, optic isomers such as enantiomers, diastereomers as pure isomers or mixtures and/or racemic mixtures as well as the pharmacologically acceptable acid addition salts with inorganic or organic acids, wherein the hydrochlorides, hydrobromides, hydroiodides, sulfates and phosphates, are preferred as addition salts with suitable inorganic acids and acetates, benzoates, 4-methoxybenzoate, 2- or 4-hydroxybenzoate, 4-chlorobenzoate, ascorbate, salicylate, formiate, glutarate, tricarballylate, citrates, fumarates, gluconates, malates, maleates, methanesulfonates, lactates, oxalates, succinates, tartrates and tosylates, for example p-tosylate are preferred as addition salts of organic acids.

4. Compounds according to one of the claims 1-3, characterized in that the substitutents labelled in formula (I)



have the following meanings:

R¹ is hydrogen, halogen, cyano, C₁-C₆-alkyl, trifluoromethyl, C₃-C₈-cycloalkyl, C₁-C₄-hydroxyalkyl, hydroxy, C₁-C₄-alkoxy, benzyloxy, C₁-C₄-alkanoyloxy, C₁-C₄-alkylthio, C₂-C₅-alkoxycarbonyl, aminocarbonyl, C₃-C₉-dialkylaminocarbonyl, carboxy, phenyl, phenoxy, pyridyloxy or NR⁵R⁶, wherein

R⁵ and

R⁶ are selected independently from each other from hydrogen and C₁-C₆-alkyl,

R² is hydrogen, halogen, C₁-C₆-alkyl, trifluoromethyl or hydroxy, wherein

R¹ and **R²**, in the case they are adjacent, optionally form a bridge which are selected from the group of bridge members -(CH₂)₄- and -(CH=CH)₂- and -CH₂O-CR⁷R⁸-O-, wherein

R⁷ and

R⁸ can be, independently from each other, hydrogen and C₁-C₆-alkyl,

R³ is selected from hydrogen, halogen and C₁-C₆-alkyl and

R⁴ is selected from hydrogen, C₁-C₆-alkyl, C₃-C₆-alkenyl, hydroxy, C₁-C₆-alkoxy and benzyloxy,

k is 0 or 1,

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A is C₂-C₆-alkenylene, which is optionally substituted one to three-fold by C₁-C₃-alkyl, hydroxy, fluorine, cyano, or phenyl, or

is C₄-C₆-alkadienylene, which is optionally substituted once or twice by C₁-C₃-alkyl, fluorine, cyano, or phenyl, or

1,3,5-hexatrienylene, which is optionally substituted by C₁-C₃-alkyl, fluorine, or cyano, as well as

ethinylene,

D is selected from C₁-C₁₀-alkylene, which is optionally substituted once or twice by C₁-C₃-alkyl or hydroxy, as well as

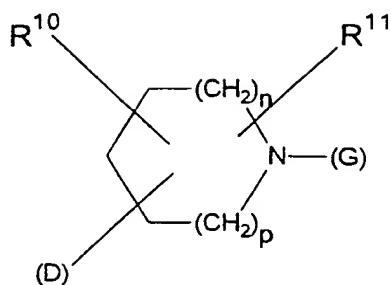
C₂-C₁₀-alkenylene, optionally substituted once or twice by C₁-C₃-alkyl or hydroxy, wherein the double bond can also be to ring E or

C₃-C₁₀-alkinylene, which is optionally substituted once or twice by C₁-C₃-alkyl or hydroxy, as well as

C₁-C₁₀-alkylene, C₂-C₁₀-alkenylene or C₃-C₁₀-alkinylene, in which one to three methylene units are isosterically replaced by O, S, NR⁹, CO, SO or SO₂, wherein

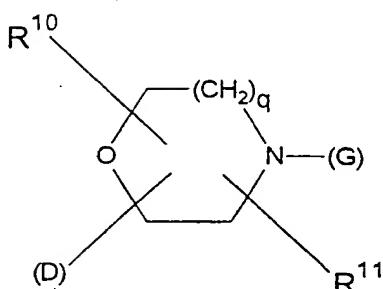
R⁹ is hydrogen, C₁-C₃-alkyl, C₁-C₆-acyl or methanesulfonyl,

E is



(E1)

or



(E2),

wherein the heterocyclic ring can optionally have a double bond and

n and p can be, independent of each other, 0, 1, 2 or 3, with the proviso that $n + p \leq 4$,

q is 2 or 3,

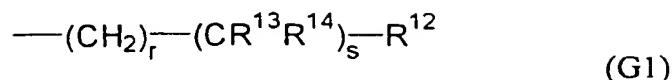
R^{10} is selected from hydrogen, C₁-C₃-alkyl, hydroxy, hydroxymethyl, carboxy or C₂-C₇-alkoxycarbonyl and

R^{11} is selected from hydrogen or an oxo group adjacent to the nitrogen atom,

G is selected from hydrogen,

G1, G2, G3, G4 and G5, wherein

G1 represents the residue



wherein

r is 0, 1 or 2 and

s is 0 or 1,

R¹² is selected from hydrogen, C₁-C₆-alkyl, C₃-C₆-alkenyl, C₃-C₆-alkinyl, C₃-C₈-cycloalkyl,

benzyl, phenyl,

monocyclic aromatic five- or six-membered heterocycles, which contain one to three hetero-atoms from the group N and/or S and/or O and are either bound directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, whereby the bond can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein one to three ring atoms can be selected from the groups N and/or S and/or O and the

bond can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

R¹³ has the same meaning as **R¹²**, but is selected independently thereof,

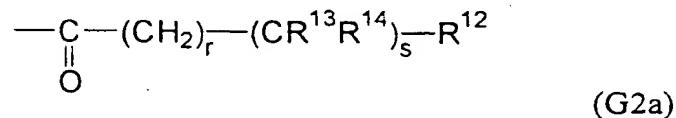
R¹⁴ is selected from hydrogen, hydroxy, methyl, benzyl or phenyl,

monocyclic aromatic five- or six-membered heterocycles, which can contain one to three hetero-atoms selected from the group N and/or S and/or O and are bound either directly or over a methylene group,

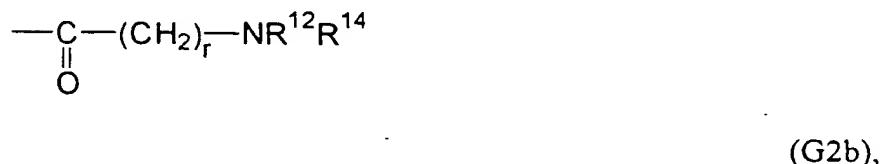
anellated bi- and tricyclic aromatic or partially hydrated carbocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein the bond can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

anellated bi- and tricyclic aromatic or partially hydrated heterocyclic ring systems with 8 to 16 ring atoms and at least one aromatic ring, wherein one to three ring atoms can be selected from the group N and/or S and/or O and the bond can occur either over an aromatic or a hydrated ring and either directly or over a methylene group,

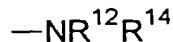
G2 is selected from the residues



and



wherein the substituents R¹² and R¹⁴ can have the above meaning, or the grouping

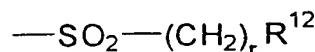


can also be a nitrogen heterocycle bound over the nitrogen atom, selected from

saturated or unsaturated monocyclic, four- to eight-membered heterocycles, which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from N and/or S and/or O, or

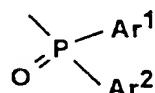
saturated or unsaturated bi- or tricyclic, anellated or bridged heterocycles with 8 to 16 ring atoms, which, aside from the essential nitrogen atom, can optionally contain one or two further hetero-atoms selected from N and/or S and/or O,

G3 is the residue



(G3),

G4 is the residue



(G4),

wherein

Ar¹ and

Ar^2 are selected independently of each other from phenyl, pyridyl or naphthyl,

G_5 is the residue

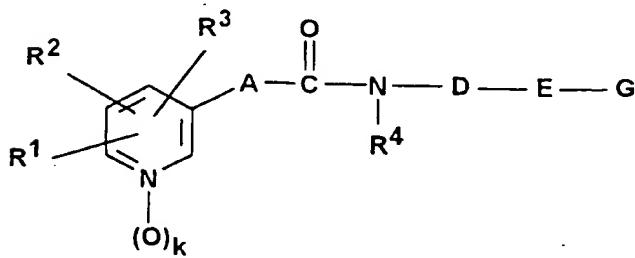
$-\text{COR}^{15}$
(G5)

wherein

R^{15} is trifluoromethyl, C₁-C₆-alkoxy, C₃-C₆-alkenyloxy or benzyloxy and

aromatic ring systems in which the substituents R^1 , R^2 , R^4 , R^{12} , R^{13} , R^{14} , R^{15} , Ar^1 and Ar^2 and/or in the ring system -NR¹²R¹⁴ can carry independently of each other one to three of the same or different substituents from the series halogen, cyano, C₁-C₆-alkyl, trifluoromethyl, C₃-C₈-cycloalkyl, phenyl, benzyl, hydroxy, C₁-C₆-alkoxy, which is optionally entirely or partially substituted by fluorine, benzyloxy, phenoxy, mercapto, C₁-C₆-alkylthio, carboxy, C₁-C₆-alkoxycarbonyl, benzyloxycarbonyl, nitro, amino, mono-C₁-C₆-alkylamino, di-(C₁-C₆-alkyl)-amino, wherein two adjacent groups on the aromatic ring or ring system can form an additional ring over a methylenedioxy bridge.

5. Compounds according to one of the claims 1-4, characterized in that the substituents labelled in formula (I)



(I)

have the following meanings:

R¹ is hydrogen, halogen, cyano, methyl, trifluoromethyl, hydroxy, C₁-C₄-alkoxy, ethylthio, methoxycarbonyl, tert-butoxycarbonyl, aminocarbonyl, carboxy, and phenoxy,

R² is hydrogen, halogen, trifluoromethyl or hydroxy,

R³ is hydrogen or halogen,

R⁴ is selected from hydrogen, C₁-C₃-alkyl, hydroxy and C₁-C₃-alkoxy,

k is 0 or 1,

A is C₂-C₆-alkenylene, which is optionally substituted once or twice by C₁-C₃-alkyl, hydroxy or fluorine,

C₄-C₆-alkadienylene, which is optionally substituted by is C₁-C₃-alkyl or by 1 or 2 fluorine atoms,

1,3,5-hexatrienylene, which is optionally substituted by fluorine, or

C₂-C₆-alkylene, wherein a methylene unit can be isosterically replaced by O, S, CO or SO₂, and the isosteric substitute, with the exception of =CO cannot be adjacent to the amide group and,

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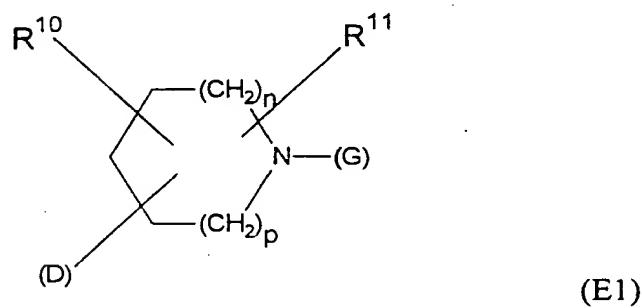
D is C₁-C₈-alkylene, which is optionally substituted once twice by methyl or hydroxy,

C₂-C₈-alkenylene, which is optionally substituted once or twice by methyl or hydroxy, wherein the double bond can also be to ring E,

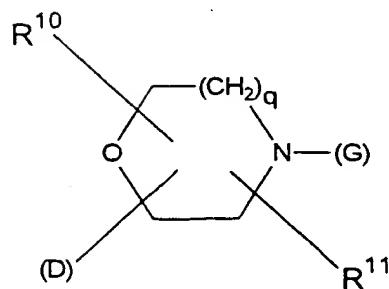
C₃-C₈-alkinylene, which is optionally substituted once or twice by methyl or hydroxy, as well as

C₁-C₈-alkylene, C₂-C₈-alkenylene or C₃-C₈-alkinylene, in which one to three methylene units are isosterically replaced by O, S, NH, N(CH₃), N(COCH₃), N(SO₂CH₃), CO, SO or SO₂,

E is



or



(E2)

wherein the heterocyclic ring can optionally have a double bond and

n and

p can be, independent of each other, 0, 1, 2 or 3, with the proviso that n + p ≤ 3,

q is 2 or 3,

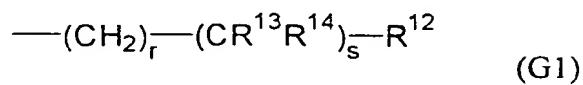
R¹⁰ is selected from hydrogen, C₁-C₃-alkyl, hydroxy, hydroxymethyl and

R¹¹ is selected from hydrogen or an oxo group which is adjacent to the nitrogen atom,

G is hydrogen or

G1, G2, G3, G4 and G5, wherein

G1 represents the residue



wherein

r is 0, 1 or 2 and

s is 0 or 1,

R¹² is selected from hydrogen, C₁-C₆-alkyl, C₃-C₈-cycloalkyl, benzyl or phenyl,

benzocyclobutyl, indanyl, indenyl, oxoindanyl, naphthyl, dihydronaphthyl, tetrahydronaphthyl, oxotetrahydronaphthyl, biphenylenyl, fluorenyl,

oxofluorenyl, anthryl, dihydroanthryl, oxodihydroanthryl, dioxodihydroanthryl, phenanthryl, dihydropheanthryl, oxodihydropheanthryl, dibenzocycloheptenyl, oxodibenzocycloheptenyl, dihydridobenzocycloheptenyl, oxodihydrodibenzocycloheptenyl, dihydridobenzocyclooctenyl, tetrahydrodibenzocyclooctenyl and oxotetrahydridobenzocyclooctenyl bound directly or over a methylene group,

furyl, thienyl, pyrrolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, pyrazolyl, imidazolyl, oxadiazolyl, thiadiazolyl, triazolyl, pyridyl, pyrazinyl, pyridazinyl, pyrimidinyl, triazinyl, imidazothiazolyl, benzofuryl, dihydrobenzofuryl, benzothienyl, dihydrobenzothienyl, indolyl, indolinyl, oxoindolinyl, dioxoindolinyl, benzoxazolyl, oxobenzoxazolinyl, benzisoxazolyl, oxobenzisoxazolinyl, benzothiazolyl, oxobenzthiazolinyl, benzoisothiazolyl, oxobenzoisothiazolinyl, benzimidazolyl, oxobenzimidazolinyl, indazolyl, oxoindazolinyl, benzofurazanyl, benzothiadiazolyl, benzotriazolyl, oxazolopyridyl, oxodihydrooxazolopyridyl, thiazolopyridyl, oxodihydrothiazolopyridyl, isothiazolopyridyl, imidazopyridyl, oxodihydroimidazopyridyl, pyrazolopyridyl, oxodihydropyrazolopyridyl, thienopyrimidinyl, chromanyl, chromanonyl, benzopyranyl, chromonyl, quinolyl, isoquinolyl, dihydroquinolyl, oxodihydroquinolinyl, tetrahydroquinolyl, oxotetrahydroquinolinyl, benzodioxanyl, quinoxalinyl, quinazolinyl, naphthyridinyl, carbazolyl, tetrahydrocarbazolyl, oxotetrahydrocarbazolyl, pyridoindolyl, acridinyl, oxodihydroacridinyl, phenothiazinyl, dihydridobenzoxepinyl; oxodihydrodibenzoxepinyl, benzocycloheptathienyl, oxobenzocycloheptathienyl, dihydrothienobenzothiepinyl, oxodihydrothienobenzothiepinyl dihydridobenzothiepinyl, oxodihydrodibenzothiepinyl, octahydrodibenzothiepinyl, dihydridobenzazepinyl, oxodihydrodibenzazepinyl, octahydrodibenzazepinyl, benzocycloheptapyridyl, oxobenzocycloheptapyridyl, dihydropyridobenzodiazepinyl, dihydridobenzoxazepinyl, dihydropyridobenzoxepinyl, dihydridobenzoxazepinyl, oxodihydropyridobenzoxazepinyl,

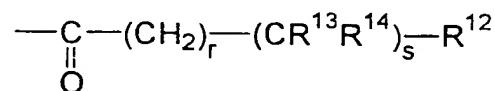
dihydrodibenzothiazepinyl, oxodihydrodibenzothiazepinyl,
 dihydropyridobenzothiazepinyl, oxodihydropyridobenzothiazepinyl, bound
 directly or over a methylene group,

R¹³ has the same meaning as **R¹²**, but is selected independently therefrom,

R¹⁴ is selected from hydrogen, hydroxy, methyl, benzyl or phenyl,

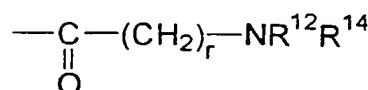
indanyl, indenyl, naphthyl, dihydronaphthyl, tetrahydronaphthyl, furyl, thienyl,
 pyrrolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, pyrazolyl, imidazolyl,
 oxadiazolyl, thiadiazolyl, triazolyl, pyridyl, pyrazinyl, pyridazinyl, pyrimidinyl,
 triazinyl, benzofuryl, benzothienyl, indolyl, indolinyl, benzoxazolyl,
 benzothiazolyl, benzimidazolyl, chromanyl, quinolyl or tetrahydroquinolyl
 bound directly or over a methylene group,

G2 is selected from the residues



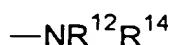
(G2a)

and



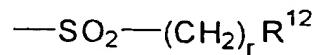
(G2b)

wherein the substituents **R¹²** and **R¹⁴** can have the above meanings, or
 represents the grouping



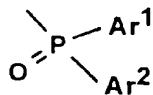
each over the nitrogen-bound ring atom of azetidine, pyrrolidine, piperidine, (1H)tetrahydropyridine, hexahydroazepine, (1H)tetrahydroazepine, octahydroazocine, pyrazolidine, piperazine, hexahydrodiazepine, morpholine, hexahydrooxazepine, thiomorpholine, thiomorpholine-1,1-dioxide, 5-aza-bicyclo[2.1.1]hexane, 2-aza-bicyclo[2.2.1]heptane, 7-aza-bicyclo[2.2.1]heptane, 2,5-diaza-bicyclo[2.2.1]heptane, 2-aza-bicyclo[2.2.2]octane, 8-aza-bicyclo[3.2.1]octane, 2,5-diazabicyclo[2.2.2]octane, 9-azabicyclo[3.3.1]nonane, indoline, isoindoline, (1H)-dihydroquinoline, (1H)-tetrahydroquinoline, (2H)-tetrahydroisoquinoline, (1H)-tetrahydroquinoxaline, (4H)-dihydrobenzoxazine, (4H)-dihydrobenzothiazine, (1H)-tetrahydrobenzo[b]azepine, (1H)-tetrahydrobenzo[c]azepine, (1H)-tetrahydrobenzo[d]azepine, (5H)-tetrahydrobenzo[b]oxazepine, (5H)-tetrahydrobenzo[b]thiazepine, 1,2,3,4-tetrahydro-9H-pyrido[3,4-b]indole, (10H)-dihydroacridine, 1,2,3,4-tetrahydroacridanone, (10H)-phenoxyazine, (10H)-phenothiazine, (5H)-dibenzazepine, (5H)-dihydrodibenzazepine, (5H)-Octahydrodibenzazepine, (5H)-dihydrodibenzodiazepine, (11H)-dihydrodibenzo[b,e]oxazepine, (11H)-dihydrodibenzo[b,e]thiazepine, (10H)-dihydrodibenzo[b,f]oxazepine, (10H)-dihydrodibenzo[b,f]thiazepine or (5H)-tetrahydrodibenzazocine,

G3 is the residue



(G3),

G4 is the residue



(G4),

wherein

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Ar¹ and

Ar² are selected independently of each other from phenyl, pyridyl or naphthyl,

G5 is the residue

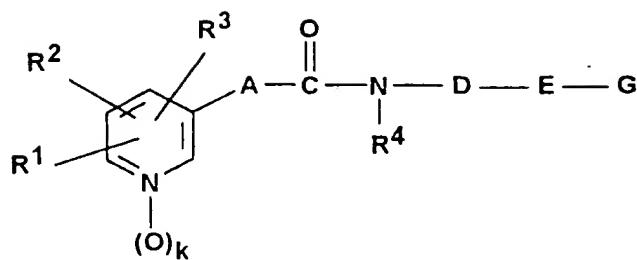


wherein

R¹⁵ is trifluoromethyl, C₁-C₆-alkoxy, C₃-C₆-alkenyloxy or benzyloxy and

aromatic ring systems in which the substituents can be substituted independently of each other by one to three of the same or different substituents from the series halogen, cyano, C₁-C₆-alkyl, trifluoromethyl, C₃-C₈-Cycloalkyl, phenyl, benzyl, hydroxy, C₁-C₆-alkoxy, C₁-C₆-alkoxy, which can be entirely or partially substituted by fluorine, can carry benzyloxy, phenoxy, mercapto, C₁-C₆-alkylthio, carboxy, C₁-C₆-alkoxycarbonyl, benzyloxycarbonyl, nitro, amino, mono-C₁-C₆-alkylamino, di-(C₁-C₆-alkyl)-amino, wherein two adjacent groups in the ring or ring system can form an additional ring over a methylenedioxy bridge.

6. Compounds according to one of the claims 1-5, characterized in that the substituents labelled in formula (I)



have the following meaning:

R¹ is hydrogen, halogen, cyano, methyl, trifluoromethyl, hydroxy, methoxy or methoxycarbonyl,

R² is hydrogen or halogen,

R³ is hydrogen,

R⁴ is selected from hydrogen, C₁-C₃-alkyl or hydroxy,

k is 0 or 1,

A is C₂-C₆-alkenylene, which is optionally substituted once or twice by hydroxy or fluorine, or

is C₄-C₆-alkadienylene, which is optionally substituted by one or two fluorine atoms, or

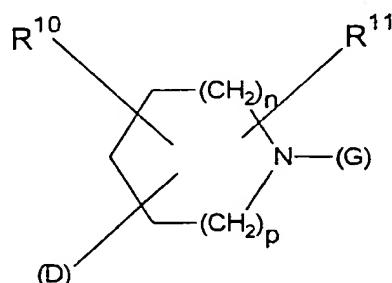
is 1,3,5-hexatrienylene

D is C₂-C₈-alkylene, which is optionally substituted by methyl or hydroxy

C_2 - C_8 -alkenylene, which is optionally substituted by methyl or hydroxy,
wherein the double bond can also be to ring E, or

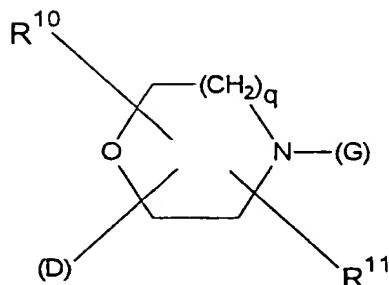
C_2 - C_8 -alkylene, C_2 - C_8 -alkenylene, wherein one to three methylene units are
isostERICALLY replaced by O, NH, N(CH₃), N(COCH₃), N(SO₂CH₃) or CO,

E is selected from the residues



(E1)

or



(E2),

wherein the heterocyclic ring can optionally have a double bond and

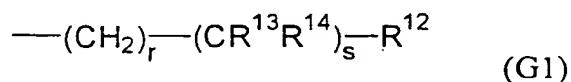
n and p can be, independent of each other, 0, 1, 2 or 3, with the proviso that n + p ≤ 3
and

q is 2

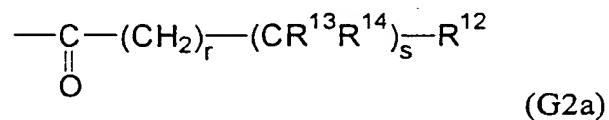
R¹⁰ is hydrogen, methyl or hydroxyl and

R¹¹ is hydrogen or an oxo group adjacent to the nitrogen atom,

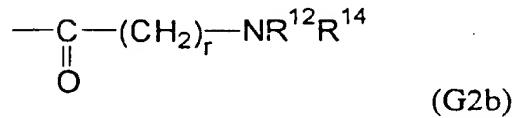
G is selected from hydrogen, C₃-C₈-cycloalkyl, methoxycarbonyl, tert-butoxycarbonyl, benzyloxycarbonyl, trifluoracetyl, diphenylphosphinoyl or the residues



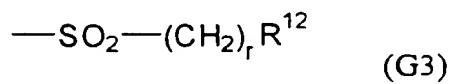
and



and



and



wherein

r is 0 to 2 and

s is 0 or 1,

R¹² is hydrogen, methyl, benzyl or phenyl,

indanyl, indenyl, oxoindanyl, naphthyl, dihydronaphthyl, tetrahydronaphthyl, oxotetrahydronaphthyl, fluorineenyl, oxofluorenyl, anthryl, dihydroanthryl, oxodihydroanthryl, dioxodihydroanthryl, dibenzocycloheptenyl, oxodibenzocycloheptenyl, dihydrodibenzocycloheptenyl, oxodihydrodibenzocycloheptenyl bound directly or over a methylene group,

furyl, thienyl, pyrrolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, pyrazolyl, imidazolyl, oxadiazolyl, thiadiazolyl, triazolyl, pyridyl, pyrazinyl, pyridazinyl, pyrimidinyl, imidazothiazolyl, benzofuryl, dihydrobenzofuryl, benzothienyl, dihydrobenzothienyl, indolyl, indolinyl, oxoindolinyl, dioxoindolinyl, benzoxazolyl, oxobenzoxazolinyl, benzisoxazolyl, oxobenzisoxazolinyl, benzothiazolyl, oxobenzthiazolinyl, benzoisothiazolyl, oxobenzoisothiazolinyl, benzimidazolyl, oxobenzimidazolinyl, benzofurazanyl, benzothiadiazolyl, benzotriazolyl, oxazolopyridyl, oxodihydrooxazolopyridyl, thiazolopyridyl, oxodihydrothiazolopyridyl, isothiazolopyridyl, imidazopyridyl, oxodihydroimidazopyridyl, pyrazolopyridyl, thienopyrimidinyl, chromanyl, chromanonyl, benzopyranyl, chromonyl, quinolyl, isoquinolyl, dihydroquinolyl, oxodihydroquinolinyl, tetrahydroquinolyl, oxotetrahydroquinolinyl, benzodioxanyl, quinoxaliny, quinazolinyl, naphthyridinyl, carbazolyl, tetrahydrocarbazolyl, oxotetrahydrocarbazolyl, pyridoindolyl, acridinyl, oxodihydroacridinyl, phenothiazinyl, dihydrodibenzoxepinyl, benzocycloheptathienyl, oxobenzocycloheptathienyl, dihydrothienobenzothiepinyl, oxodihydrothienobenzothiepinyl, dihydronitrobenzothiepinyl, oxodihydronitrobenzothiepinyl,

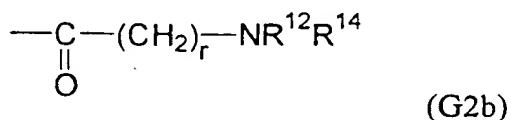
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dihydrodibenzazepinyl, oxodihydrodibenzazepinyl, octahydrodibenzazepinyl,
 benzocycloheptapyridyl, oxobenzocycloheptapyridyl,
 dihydropyridobenzoxepinyl, dihydrodibenzothiazepinyl,
 oxodihydrodibenzothiazepinyl bound directly or over a methylene group,

R¹³ is hydrogen, methyl, benzyl or phenyl,

R¹⁴ is selected from hydrogen, hydroxy, methyl, benzyl, phenyl,

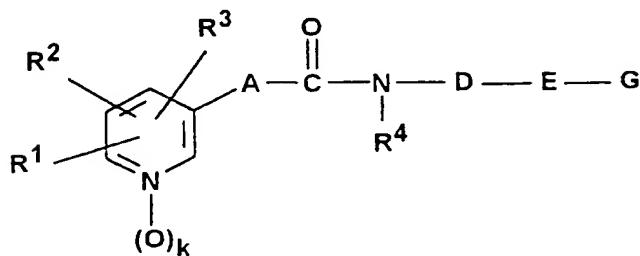
naphthyl, furyl, thienyl, oxazolyl, thiazolyl, pyrazolyl, imidazolyl, oxadiazolyl,
 thiadiazolyl, pyridyl, benzofuryl, benzothienyl, indolyl, indolinyl, benzoxazolyl,
 benzothiazolyl, benzimidazolyl, chromanyl, quinolyl or tetrahydroquinolyl,
 bound directly or over a methylene group, wherein in formula (I)



$\text{---NR}^{12}\text{R}^{14}$ can also be selected from pyrrolidine, piperidine,
 (1H)tetrahydropyridine, hexahydroazepine, Octahydroazocene, piperazine, hexa-
 hydrodiazepine, morpholine, hexahydrooxazepine, 2-azabicyclo[2.2.1]heptane,
 7-azabicyclo[2.2.1]heptane, 2,5-diazabicyclo[2.2.1]heptane, 8-
 azabicyclo[3.2.1]octane, 2,5-diazabicyclo[2.2.2]octane, indoline, isoindoline,
 (1H)-dihydroquinoline, (1H)-tetrahydroquinoline, (2H)-tetrahydroisoquinoline,
 (1H)-tetrahydroquinoxaline, (4H)-dihydrobenzoxazine, (4H)-
 dihydrobenzothiazine, (1H)-tetrahydrobenzo[b]azepine, (1H)-tetrahydroben-
 zo[d]azepine, (5H)-tetrahydrobenzo[b]oxazepine, (5H)-
 tetrahydrobenzo[b]thiazepine, 1,2,3,4-tetrahydro-9H-pyrido[3,4-b]indol, (10H)-
 dihydroacridine, 1,2,3,4-tetrahydroacridanone, (5H)-dihydrodibenzazepine,
 (5H)-dihydrodibenzodiazepine, (11H)-dihydrodibenzo[b,e]oxazepine, (11H)-

dihydrodibenzo[b,e]thiazepine, (10H)-dihydrodibenzo[b,f]oxazepine or (5H)-tetrahydrodibenzazocine.

7. Compounds according to one of the claims 1-6, characterized in that the substituents labelled in the formula (I)



have the following meanings:

R¹ is hydrogen, fluorine, chlorine, bromine, methyl, trifluoromethyl or hydroxy,

R² and

R³ are hydrogen,

R⁴ is hydrogen or hydroxy,

k is 0 or 1,

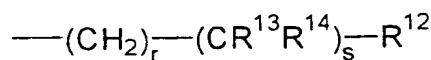
A is C₂-C₄-alkylene, which is optionally substituted by fluorine,

D is selected from C₂-C₆-alkylene, C₂-C₆-alkenylene, wherein the double bond can also be to ring E, and C₂-C₆-alkylene and C₂-C₆-alkenylene, wherein a methylene unit is isosterically replaced by O, NH, N(CH₃) or CO or an ethylene

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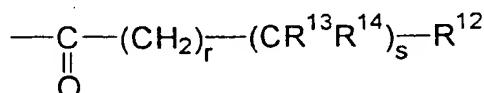
group is isosterically replaced by NH-CO and/or CO-NH or a propylene group can be isosterically replaced by NH-CO-O and/or O-CO-NH,

- E** is selected from pyrrolidine, piperidine, 1,2,5,6-tetrahydropyridine, hexahydroazepine, morpholine and hexahydro-1,4-oxazepine, wherein the heterocyclic ring optionally adjacent to the nitrogen atom can be substituted by an oxo group,
- G** is selected from hydrogen, tert-butoxycarbonyl, diphenylphosphinoyl, or one of the residues



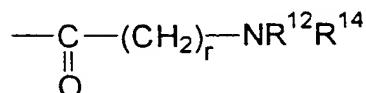
(G1)

and



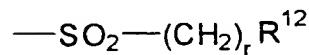
(G2a)

and



(G2b)

and



(G3)

wherein

r is 0 or 1 and

s is 0 or 1,

R¹² is hydrogen, methyl, benzyl or phenyl,

indenyl, oxoindanyl, naphthyl, tetrahydronaphthyl, fluorenyl, oxofluorenyl, anthryl, dihydroanthryl, oxodihydroanthryl, dioxodihydroanthryl, dibenzocycloheptenyl, dihydromibenzocycloheptenyl bound directly or over a methylene group,

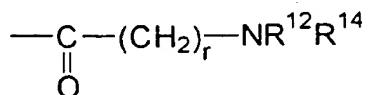
furyl, thienyl, oxazolyl, thiazolyl, imidazolyl, oxadiazolyl, thiadiazolyl, pyridyl, pyrazinyl, pyrimidinyl, imidazothiazolyl, benzofuryl, benzothienyl, indolyl, oxoindolinyl, dioxoindolinyl, benzoxazolyl, oxobenzoxazolinyl, benzothiazolyl, oxobenzthiazolinyl, benzimidazolyl, oxobenzimidazolinyl, benzofurazanyl, benzotriazolyl, oxazolopyridyl, oxodihydrooxazolopyridyl, thiazolopyridyl, oxodihydrothiazolopyridyl, chromanyl, chromanonyl, benzopyranyl, chromonyl, quinolyl, isoquinolyl, oxodihydroquinolinyl, tetrahydroquinolyl, oxotetrahydroquinolinyl, benzodioxanyl, quinazolinyl, acridinyl, oxodihydroacridinyl, phenothiazinyl, dihydromibenzoxepinyl, benzocycloheptathienyl, dihydrothienobenzothiepinyl, dihydromibenzothiepinyl, oxodihydrodibenzothiepinyl, dihydromibenzazepinyl, oxodihydrodibenzazepinyl, octahydrodibenzazepinyl, benzocycloheptapyridyl, oxobenzocycloheptapyridyl, dihydromibenzothiazepinyl bound directly or over a methylene group,

R¹³ is hydrogen, methyl, benzyl or phenyl,

R¹⁴ is hydrogen, hydroxy, methyl, benzyl or phenyl,

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naphthyl, furyl, thienyl, pyridyl, benzofuryl, benzothienyl, indolyl, benzoxazolyl, benzothiazolyl, benzimidazolyl, chromanyl, quinolyl or tetrahydroquinolyl bound directly or over a methylene group, wherein in the formula



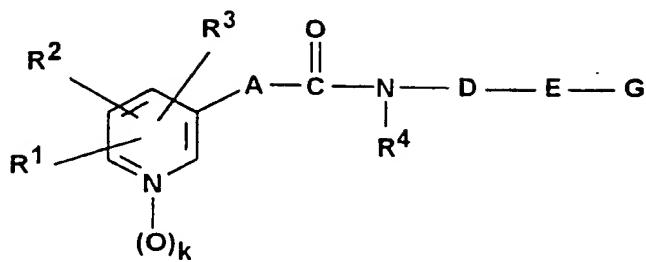
(G2b)

$\text{---NR}^{12}\text{R}^{14}$ can be selected from pyrrolidine, piperidine, hexahydroazepine, morpholine, 2,5-diazabicyclo[2.2.1]heptane, indoline, isoindoline, (1H)-dihydroquinoline, (1H)-tetrahydroquinoline, (2H)-tetrahydroisoquinoline, (1H)-tetrahydrobenzo[b]azepine, (1H)-tetrahydrobenzo[d]azepine, (5H)-tetrahydrobenzo[b]oxazepine, (5H)-tetrahydrobenzo[b]thiazepine, 1,2,3,4-tetrahydroacridanone, (5H)-dihydronibenzazepine, (11H)-dihydronibenz[b,e]-oxazepine or (11H)-dihydronibenz[b,e]thiazepine and

wherein aromatic ring systems in the substituents can be substituted, independently of each other, by one to three of the same or different substituents from the series halogen, cyano, C₁-C₆-alkyl, trifluoromethyl, C₃-C₈-cycloalkyl, phenyl, benzyl, hydroxy, C₁-C₆-alkoxy, C₁-C₆-alkoxy, which can be entirely or partially substituted by fluorine, can carry benzyloxy, phenoxy, mercapto, C₁-C₆-alkylthio, carboxy, C₁-C₆-alkoxycarbonyl, benzyloxycarbonyl, nitro, amino, mono-C₁-C₆-alkylamino or di-(C₁-C₆-alkyl)-amino, whereby two adjacent groups on the aromatic ring or ring system can form an additional ring over a methylenedioxy bridge.

8. Compounds according to one of the claims 1-7, characterized in that the substituents labelled in the formula (I)

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have the following meanings:

R¹ is hydrogen, fluorine, methyl, trifluoromethyl or hydroxy,

R² and

R³ are hydrogen,

R⁴ is hydrogen or hydroxy,

k is 0,

A ethenylene(vinylene) or 1,3-butadienylene

D is selected from C₂-C₆-alkylene or C₂-C₆-alkenylene, wherein the double bond can also be to ring E,

E is selected from pyrrolidine, piperidine, hexahydroazepine or morpholine,

G is selected from benzyl, phenethyl, fluorenylmethyl, anthrylmethyl, diphenylmethyl, fluorenyl or dihydrodibenzocycloheptenyl, furylmethyl, thiencylmethyl, thiazolylmethyl, pyridylmethyl, benzothienylmethyl, quinolylmethyl, phenyl-thienylmethyl, phenyl-pyridylmethyl,

dihydrodibenzoxepinyl, dihydrodibenzothiepinyl,
acetyl, pivaloyl, phenylacetyl, diphenylacetyl, diphenylpropionyl, naphthylacetyl,
benzoyl, naphthoyl, anthrylcarbonyl, oxofluorenylcarbonyl, oxodihydro-
anthrylcarbonyl or dioxodihydroanthrylcarbonyl,
furoyl, pyridylcarbonyl, chromonylcarbonyl, quinolylcarbonyl,
naphthylaminocarbonyl, dibenzylaminocarbonyl, benzylphenylaminocarbonyl,
diphenylaminocarbonyl, indolinyl-1-carbonyl, dihydrodibenzazepin-N-carbonyl,
tetrahydroquinolinyl-N-carbonyl, tetrahydrobenzo[b]azepinyl-N-carbonyl,
methanesulfonyl, phenylsulfonyl, p-toluenesulfonyl, naphthylsulfonyl,
quinolinsulfonyl and
diphenylphosphinoyl,

wherein aromatic ring systems can be substituted independently of each other
by one to three of the same or different substituents from the series halogen,
cyano, C₁-C₆-alkyl, trifluoromethyl, C₃-C₈-cycloalkyl, phenyl, benzyl,
hydroxy, C₁-C₆-alkoxy, C₁-C₆-alkoxy, which can be entirely or partially
substituted by fluorine, benzyloxy, phenoxy, mercapto, C₁-C₆-alkylthio,
carboxy, C₁-C₆-alkoxycarbonyl, benzyloxycarbonyl, nitro, amino, mono-C₁-
C₆-alkylamino or di-(C₁-C₆-alkyl)-amino, wherein two adjacent groups in the
ring or ring system can form an additional ring over a methylendioxy bridge.

9. Compound according to one of the claims 1-8, characterized in that it is present
in the form of

N-[4-(1-methylsulfonylpiperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide,

N-{4-[1-(2-naphthylsulfonyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-{4-[1-(2-naphthylsulfonyl)-piperidin-4-yl]-butyl}-5-(pyridin-3-yl)-2,4-pentadienoic acid amide,

N-{4-[1-(1-naphthylaminocarbonyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-[4-(1-diphenylaminocarbonyl-piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide,

N-[4-(1-diphenylaminocarbonyl-piperidin-4-yl)-butyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide,

N-{4-[1-(10,11-dihydrodibenzo[b,f]azepin-5-yl-carbonyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide or

N-[4-(1-diphenylphosphinoyl-piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide

and/or as a pharmaceutically acceptable acid addition salt thereof.

10. Compound according to any one of the claims 1-8, characterized in that it is present in the form of

N-[4-(1-acetyl piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide,

N-[4-(1-diphenylacetyl-piperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide,

N-{4-[1-(3,3-diphenylpropionyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-[4-(1-benzoylpiperidin-4-yl)-butyl]-3-(pyridin-3-yl)-acrylamide,

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N-[4-(1-benzoylpiperidin-4-yl)-butyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide, or

N-{4-[1-(9-oxo-9H-fluoro-4-yl-carbonyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide

and/or as a pharmaceutically acceptable acid addition salt thereof.

11. Compound according to any one of the claims 1-8, characterized in that it is present in the form of

N-{4-[1-(phenylpyridin-3-yl-methyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-{4-[1-(phenylpyridin-4-yl-methyl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide,

N-{4-[1-(6,11-dihydrodibenzo[b,e]oxepin-11-yl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide, or

N-{4-[1-(6,11-dihydrodibenzo[b,e]thiepin-11-yl)-piperidin-4-yl]-butyl}-3-(pyridin-3-yl)-acrylamide

and/or as a pharmaceutically acceptable acid addition salt thereof.

12. Compound according to any one of the claims 1-8, characterized in that it is present in the form of

N-[7-(1-diphenylmethylpiperidin-4-yl)-heptyl]-3-(pyridin-3-yl)-acrylamide,

N-[8-(1-diphenylmethylpiperidin-4-yl)-octyl]-3-(pyridin-3-yl)-acrylamide,

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N-[3-(1-diphenylmethylpiperidin-4-yloxy)-propyl]-3-(pyridin-3-yl)-acrylamide, or

N-[3-(1-benzylpiperidin-4-yloxy)-propyl]-3-(pyridin-3-yl)-acrylamide

and/or as a pharmaceutically acceptable acid addition salt thereof.

13. Compound according to any one of the claims 1-8, characterized in that it is present in the form of

N-[2-(1-diphenylmethylpiperidin-4-yl)-ethyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide,

N-[4-(1-diphenylmethylpiperidin-4-yl)-butyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide,

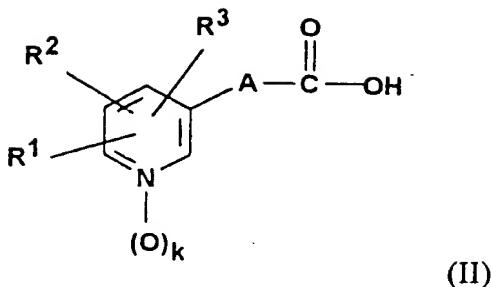
N-[5-(1-diphenylmethylpiperidin-4-yl)-pentyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide or

N-[6-(1-diphenylmethylpiperidin-4-yl)-hexyl]-5-(pyridin-3-yl)-2,4-pentadienoic acid amide

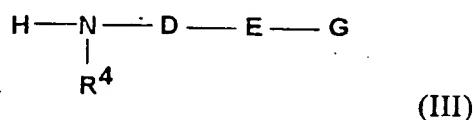
and/or as a pharmaceutically acceptable acid addition salt thereof.

14. Method for the production of compounds according to formula (I) according to one of the claims 1-13 characterized in that either

(a) carboxylic acids of formula (II)



in which R^1 , R^2 , R^3 , A and k have the meaning given above or their reactive derivatives are reacted with compounds of formula (III)



wherein D , E , G and R^4 have the meanings given in claims 1-8 or

(b) compounds of formula (I), wherein G is hydrogen, are reacted with a compound of formula (IV),



in which G has the meaning given in claims 1-8, with the exception of hydrogen, and L represents a suitable nucleofuge or reactive group, whereby the type of specific nucleofuge or reactive group L as well as the reaction conditions are dependent on the nature of the residue G , or

(c) compounds of formula (I), in which G has the meaning of $G1$ according to claims 1-7, with the exception of hydrogen, are produced in a such a manner that compounds of formula (I), in which G is hydrogen, are reacted with a suitable alkylation agent and/or arylation agent of formula (IV) according to the above variant (b), wherein G is an alkyl-, alkenyl-, alkinyl-, cycloalkyl-, aryl-, aralkyl-, heteroaryl- or heteroaralkyl

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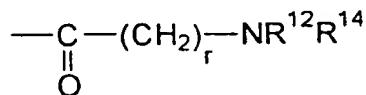
residue according to definition and the nucleofuge L can be a reactive derivative of an alkohol, for example, a halogen atom such as chlorine, bromine or iodine or a sulfonic acid ester, i.e. for example a methanesulfonyloxy-, trifluoromethanesulfonyloxy-, ethanesulfonyloxy-, benzenesulfonyloxy-, p-toluenesulfonyloxy-, p-bromobenzenesulfonyloxy- or m-nitrobenzenesulfonyloxy residue, etc. or a reactive group L can be an epoxide group,

(d) compounds of formula (I), in which G represents an acyl, carbamoyl, sulfonyl or a phosphinoyl residue according to the above definition are produced in such a manner that compounds of formula (I), in which G is hydrogen, are reacted with a carboxylic, carbamic, sulfonic and/or phosphinic acid of formula (V),



wherein G is an acyl, carbamoyl, sulfonyl or phosphinoyl residue according to definition, or with derivatives thereof capable of reaction, whereby symmetric or unsymmetric carboxylic acid anhydrides and/or sulfonic acid anhydrides or acyl- and/or sulfonyl halides, especially acyl- and/or sulfonyl chlorides and carbamoyl halides and/or phosphinic acids are used as preferred derivatives of carboxylic acids and/or sulfonic acids (V) capable of reaction, and the reaction of the acids (V) and/or their reactive derivatives with the compounds (I), in which G is hydrogen, preferably occurs in the presence of auxiliary bases in solvents and under conditions as they are described in variant (a), or

(e) compounds of formula (I), in which G represents a carbamoyl residue according to the definition (G2b) in the form of the grouping



wherein r = 0

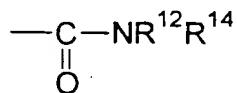
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are produced in such a manner that compounds of formula (I), in which G is hydrogen are reacted with a carbonyl group transmitter to an intermediate product and the latter, without its purification or previous isolation, is brought to reaction with a primary or secondary amine with the formula (VI)

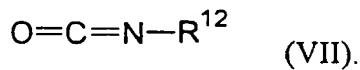


wherein R¹² and R¹⁴ and/or the grouping —NR¹²R¹⁴ have the meanings according to claims 1-7, wherein bis-(trichloromethyl) carbonate (triphosgene) and carbonyldiimidazol are used as particularly reactive carbonyl group transmitters and the reaction of compounds of formula (I), wherein G is hydrogen, with triphosgene and/or carbonyldiimidazol is preferably carried out in an absolute, inert solvent in the presence of a tertiary organic amine as an auxiliary base in such a manner that the solution of compounds (I) and the auxiliary base are slowly added to a solution of an equivalent amount of carbonyl group transmitter, or

(f) compounds of formula (I), in which G is a carbamoyl residue according to the definition G2, with r = 0 and R¹⁴ = hydrogen, with grouping



are produced in such a manner that compounds of formula (I), in which G is hydrogen, are brought into reaction with an isocyanate of the formula (VII)



in which R¹² has the meaning as given in claims 1-7, wherein the reaction of the compounds of formula (I), in which G is hydrogen, with the isocyanates of formula (VII) preferably occurs in an absolute, inert solvent, such as for example, a hydrocarbon such as pentane, hexane, heptane, benzene, toluene, or xylene, chlorinated hydrocarbons (such as dichloromethane, chloroform, 1,2-dichloroethane, trichloroethylene), ethers (for example, diethyl ether, tetrahydrofuran, dioxane), esters such as ethyl acetate, butyl acetate, or polar aprotic solvents such as formamide or dimethylformamide and/or mixtures thereof and the reaction temperatures can lie in the region from -20°C to 150°C, but can preferably vary from 20°C to 100°C, or

(g) compounds of formula (I), in which R⁴ is an alkyl, alkenyl, alkinyl or cycloalkyl residue according to the above definition are produced in such a manner that compounds of the formula (I), in which R⁴ is hydrogen, are reacted with a suitable alkylation agent of formula (VIII)



in which R⁴ is an alkyl, alkenyl, alkinyl or cycloalkyl residue according to definition and L represents a suitable nucleofuge, i.e. for example a halogen atom such as chlorine, bromine or iodine or a sulfonic acid ester of an alcohol, wherein sulfonic acid esters of formula (VIII) especially contain a methylsulfonyloxy group, trifluoromethanesulfonyloxy-, p-toluenesulfonyloxy-, p-bromobenzenesulfonyloxy- or m-nitrobenzenesulfonyloxy group as a nucleotype L and the amide alkylation is carried out in the presence of tertiary amino groups under the use of strong auxiliary bases such as potassium tert-butylate, sodium hydride, potassium hydride or butyl lithium in aprotic, inert solvents, for example, aliphatic or aromatic hydrocarbons such as pentane, hexane, heptane, benzene, toluene or ethers such as tetrahydrofuran, dioxane, or polar solvents such as dimethylsulfoxide, dimethylformamide, N-methylpyrrolidone, wherein the reaction temperature can lie between -40°C and 140°C, preferably between -20°C and 80°C, depending on the reactivity of the educts.

15. Method according to claim 14, characterized in that as reactive derivatives of compound (II) their activated esters, anhydrides, acid halides, (especially acid chlorides), simple low alkyl esters, especially the p-nitrophenyl esters 2,4,6-trichlorophenyl esters, pentachlorophenyl esters, cyanomethyl esters, esters of N-hydroxysuccinimide, N-hydroxyphthalimide, 1-hydroxybenzotriazol, N-hydroxypiperidine, 2-hydroxypyridine or 2-mercaptopypyridine are used according to method variant (a), wherein symmetric as well as mixed anhydrides or for example those from the reaction with pivoyl chloride or with chloroformates, for example, aromatic chloroformates such as chloroformic acid phenyl ester, aliphatic chloroformates such as chloroformic acid benzyl ester or aliphatic chloroformates such as chloroformic acid methyl ester, ethyl ester or isobutyl ester are used as anhydrides, and the reaction of the compounds (II) with the compounds (III) can be facultatively performed in the presence of condensation agents such as dicyclohexylcarbodiimide, 1-ethyl-3-(3-dimethylaminopropyl)-carbodiimide hydrochloride, N,N'-carbonyldiimidazol or 1-ethoxycarbonyl-2-ethoxy-1,2-dihydroquinoline, wherein

in the case of carbodiimides as a condensation agent, especially N-hydroxysuccinimide, N-hydroxyphthalimide, 1-hydroxybenzotriazol or N-hydroxypiperidine can be added, and

the compounds of formula (III) as free bases as well as in form of their acid addition salts can be brought to reaction, especially in form of salts of organic acids such as hydrochlorides, hydrobromides, or sulfates and the reaction of compounds of formula (II), optionally in form of their reactive derivatives, is performed with compounds (III) in a suitable, preferably inert, solvent such as aromatic hydrocarbons such as benzene, toluene, xylene, halogenated hydrocarbons such as dichloromethane, chloroform, 1,2-dichloroethane, trichloroethylene, or ethers such as diethyl ether, tetrahydrofuran, dioxane, glycol dimethyl ether, ethylacetate, acetonitrile or polar aprotic solvents such as dimethylsulfoxide, dimethylformamide or N-methylpyrrolidone as such in pure form or as mixtures of two or more thereof, wherein

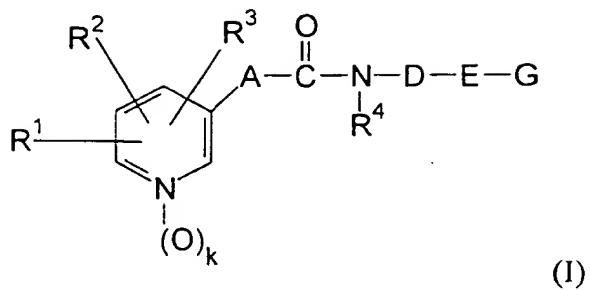
the reaction is optionally carried out in the presence of an auxiliary base such as alkali metal carbonates, for example sodium carbonate, potassium carbonate, alkali metal hydrogen carbonates such as sodium hydrogen carbonate, potassium hydrogen carbonate, or organic bases such as triethylamine, ethyldiisopropylamine, tributylamine, N-methylmorpholine or pyridine, wherein a suitable excess of the compound of formula (III) can be used as a base, and in case of use of the compounds of formula (III) in form of their acid addition salts, the amount of the auxiliary base is considered equivalent, and

the reaction temperatures preferably lie between -40°C and 180°C, especially between -10°C and 130°C, preferably at the boiling point of the solvent used.

16. Method according to claim 14, characterized in that according to method variant (b), the reaction of compounds (I), in which G is hydrogen, with compounds according to formula (IV) can be carried out in an inert solvent such as aromatic hydrocarbons for example, benzene, toluene, xylene, or ethers, for example, in tetrahydrofuran, dioxane, glycol dimethyl ether, or in ethylacetate, acetonitrile, ketones such as acetone, ethyl methyl ketone, in polar protic solvents such as alcohols such as ethanol, isopropanol, butanol, glycol monomethyl ether or polar aprotic solvents such as dimethylsulfoxide, dimethylformamide or N-methylpyrrolidone, wherein pure solvent as well as mixtures of two or more of them can be used, and the reactions can be carried out in the presence of bases, for example in the presence of the same as they can be used according to the method variant (a) according to claim 15, and, in the case of the chlorides or bromides as compounds (IV), addition of alkali metal iodides such as sodium iodide or potassium iodide occurs and the reaction temperatures can vary between 0°C and 180°C, however, preferably between 20°C and 130°C, depending on the reactivity of the educts.

17. Compounds according to the general formula (I)

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wherein G is hydrogen and the remaining substituents have the meanings given in the claims 1-7.

18. Compound or compound mixture according to one of the claims 1-13 and 17 for use in a therapeutic method for treatment of the human or animal body or in a corresponding diagnosis method.

19. Compound or compound mixture for use in a therapeutic method according to claim 18, characterized in that the therapeutic use is in connection with cancerostatic or cytostatic or immunosuppressive treatment, optionally in connection with suitable pharmaceutically acceptable adjuvants and carriers and/or one or more further active ingredients.

20. Use of one or more compounds according to one of the claims 1-13 and 17, including (E)-3-(3-pyridyl)-N-[2-(1-benzylpiperidine-4-yl)ethyl]-2-propenamide hydrochloride, for the preparation of a medicament for treatment of the human or animal body in the medical indications named above in claim 19.

21. Use of one or more compounds according to one of the claims 1-13 and 17, including (E)-3-(3-pyridyl)-N-[2-(1-benzylpiperidine-4-yl)ethyl]-2-propenamide hydrochloride, for the production of a medicament for cytostatic treatment of the human or animal body.

22. Medicament with an amount of one or more active ingredients according to one or more of the claims 1-13 and 17, optionally in connection with a pharmaceutically acceptable carrier, aside from toxicologically safe adjuvants, and/or in combination with other active ingredients.

23. Method for the production of a medicament according to claim 22, characterized in that one or more of the compounds according to one or more of the claims 1-13 and 17 are processed with suitable, pharmaceutically acceptable carriers and adjuvants to a finished medical form.

24. Medicament according to claim 22, characterized in that it is present in the form of a solid, peroral administration form as a tablet, capsule, coated tablet, optionally in sustained action or gastric fluid-resistant form, or as a liquid, peroral administration solution, suspension, effervescent tablet, in the form of tabs or sachets, optionally in sustained action, if possible, or in gastric fluid-resistant form.

25. Medicaments according to claim 22, characterized in that it is present in the form of a suitable injection or infusion preparation together with suitable pharmaceutically acceptable carriers and adjuvants, optionally in sustained action form or as a parenteral depot medicinal form or implant or is used in the form of a concentrate, powder or lyophilisate and the parenteral dilution agent is optionally manufactured in the packaging separately therefrom, wherein the mixing of both compounds with each other or of the active ingredient with a common parenterally applicable dilution agent occurs immediately before use.

26. Medicament according to claim 22, characterized in that it is present in the form of an inhalation therapeutic agent, for example, in the form of a spray together with suitable pharmaceutically acceptable propellants, carriers and adjuvents.

27. Medicament according to claim 22, characterized in that it is present in the form of a transdermal therapeutic system for systemic treatment.

28. Medicament according to claim 22, characterized in that it is present in the form of a gastrointestinal therapeutic system for systemic treatment.
29. Medicament according to claim 22, characterized in that it is present in the form of a salve, suspension, emulsion, a balm or plaster or in the form of an externally applicable solution.
30. Medicament according to claim 26 for administration by means of a controlled dosage aerosol or in the form of a dry powder dosage formulation.
31. Medicament according to claim 22, characterized in that it is present in the form of a rectal, genital, or transurethral administration emulsion, a solution, a liposomal solution, an implant, suppository or a capsule.
32. Medicament according to claim 22, characterized in that it is present in the form of a nasal, otologic or ophthalmologic composition.
33. Medicament according to claim 22 or 24, characterized in that it is present in the form of a buccally applicable form.
34. Medicament according to claim 22 and 24, characterized in that a dosage unit for single administration contains 0.01 to 2.0 mg or 0.1-10 or 20 mg active ingredient according to the claims 1-13 and 17.
35. Medicament according to claim 26, characterized in that the pharmaceutically acceptable carrier and/or diluent is a propellant aerosol.
36. Medicament according to claim 26 or 35, characterized in that the propellant aerosol is tetrafluoroethane and/or heptafluoropropane and/or propane, butane, or dimethyl ether or mixtures thereof.

37. Medicament according to claim 26, 35 or 36, characterized in that the propellant aerosol contains surface active adjuvants.
38. Medicament according to claim 22 or 26, characterized in that it contains glucose and/or lactose as a dry powder dosage.
39. Substance or substance mixture according to claim 19 or 20, characterized in that the therapeutic use is suitable in connection with the combination with a further cytostatic agent or immunosuppressive agent.
40. Medicament according to claim 22 and 24, characterized in that it is present in combination with a further cytostatic agent or immunosuppressive agent, optionally in the form of separate dosage units in the pharmaceutical package.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 97/03245

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C07D401/12 C07D405/14 C07D409/14 A61K31/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C07D A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|------------------------------------------------------------------------------------------------------------------|-----------------------|
| X | EP 0 330 026 A (TAKEDA CHEMICAL INDUSTRIES LTD) 30 August 1989 cited in the application see table 1 --- | 1-40 |
| A | EP 0 343 307 A (ESPAÑOLA PROD QUIMICOS) 29 November 1989 see the whole document ----- | 1-40 |

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- 'A' document defining the general state of the art which is not considered to be of particular relevance
- 'E' earlier document but published on or after the international filing date
- 'L' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified).
- 'O' document referring to an oral disclosure, use, exhibition or other means
- 'P' document published prior to the international filing date but later than the priority date claimed

- 'T' later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- 'X' document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- 'Y' document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- '&' document member of the same patent family

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Date of the actual completion of the international search

23 September 1997

Date of mailing of the international search report

30.09.97

Name and mailing address of the ISA

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Authorized officer

Bosma, P

INTERNATIONAL SEARCH REPORT

International application No.

PCT/EP 97/03245

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: 1-8, 17 because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
The subject-matter of the present claims 1-8, 17 is so broad that a complete search is not possible on economic grounds (PCT Search Guidelines III, 3.6 and 3.7). Therefore the search has been based on the examples and the other claims.

3. Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

The additional search fees were accompanied by the applicant's protest

No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 97/03245

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|----------------------------------------|------------------|-------------------------------------------------------------------------------|----------------------------------------------------------|
| EP 0330026 A | 30-08-89 | AT 112560 T DE 68918609 D DE 68918609 T JP 2138255 A US 5169856 A | 15-10-94 10-11-94 04-05-95 28-05-90 08-12-92 |
| EP 0343307 A | 29-11-89 | NONE | |

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